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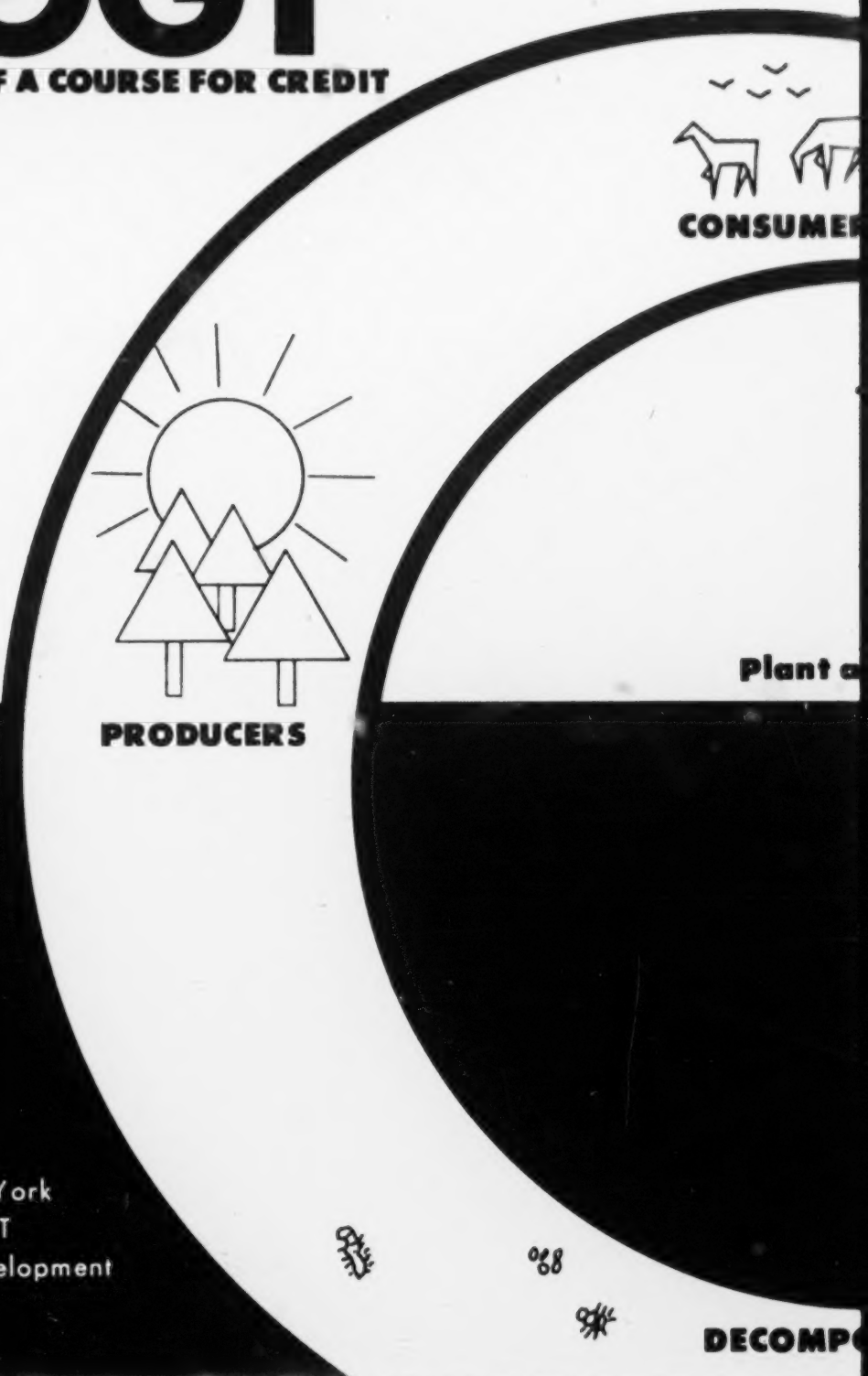
ABSTRACT

The syllabus for a general biology course (which may be used for one Group III credit as an elective toward a New York State Regents High School Diploma) contains five major units. These units - Life Functions, Systems of the Human Body, Continuation of Life, The Green Plants, and Classification and Evolution - are designed to "involve the nonscience-oriented student in a wide variety of creative experiences." Behavioral objectives for the course are stated, and, for each unit, the necessary understandings and activities related to the development of these understandings are listed. Appendices contain additional teaching notes for many of the activities and a short list of general reference books. The syllabus is considered to be under field evaluation in this edition. Feedback forms for teacher comments are included at the end of each unit. (AL)

ED 059893

GENERAL BIOLOGY

1971 REVISED SYLLABUS OF A COURSE FOR CREDIT AS A GROUP 3 ELECTIVE



SE 013 377

The University of the State of New York
THE STATE EDUCATION DEPARTMENT
Bureau of Secondary Curriculum Development
Albany, N. Y. 12224

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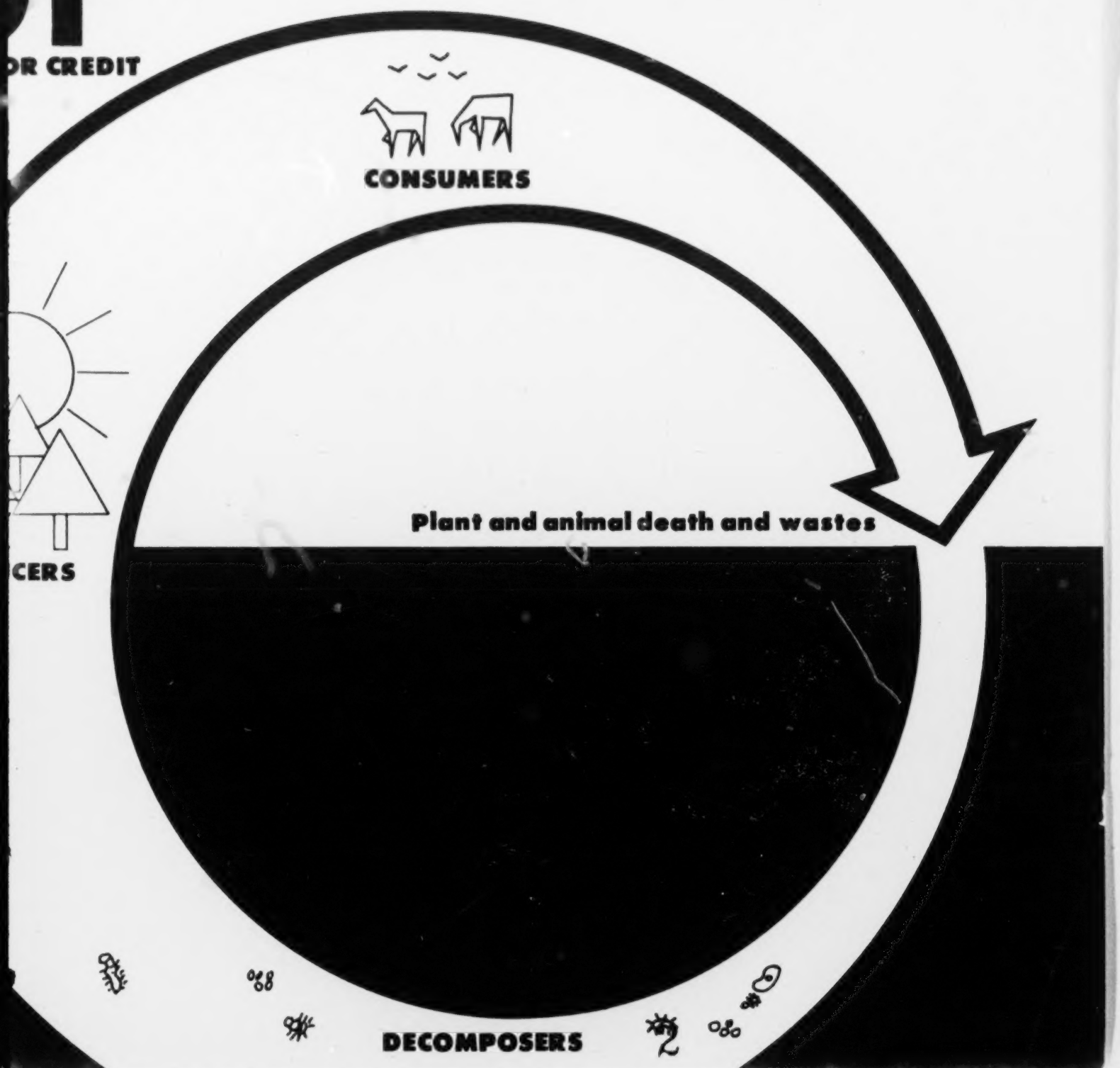

G E N E R A L B I O L O G Y

-- A State course of study for credit as
a Group 3 elective toward a State
Regents High School Diploma

1971 Prototype Edition

The University of the State of New York/The State Education Department
Bureau of Secondary Curriculum Development/Albany, New York 12224

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FOREWORD

This publication is the second step in the development of a new State syllabus for a course in general biology which may be used as a Group 3 elective. As with the syllabuses for general chemistry and general physics, this course is designed for nonscience majors who would benefit from a senior high school science course.

This course in general biology is intended for the average or slightly below average student whose interests and goals may be different from those who take the Regents biology course which is used for credit as part of the 3-unit, Group 2, major sequence or as an elective for the majority of the average and above average students. In addition to the two State biology courses, some schools will still need to develop their own local credit course for low or below average pupils.

Teachers who use this material may substitute or add to the student activities; modify or add to the understandings; and modify or reorder the sequence to suit the needs of their students. AN EVALUATION FORM IS PROVIDED FOR EACH OF THE UNITS WHICH IS TO BE COMPLETED AND RETURNED TO THE BUREAU OF SCIENCE EDUCATION WHEN THE UNIT IS COMPLETED.

A special State examination for June 1972 will be prepared by a committee of teachers who are using this new syllabus. The raw score on this examination will be used as a partial determinant of the final mark.

The preliminary outline for the 1969 edition was prepared by a special advisory committee in March 1969. Members of this committee were: Otto Burgdorf, William C. Bryant High School, New York City; Lee Burland, Columbia High School, East Greenbush; Sister Leo Francis, Molloy College, Rockville Centre; Mrs. Maxine Hancock, Duanesburg Central School, Delanson; Ralph Lomio, Benjamin Franklin High School, Rochester; Samuel Mole, East High School, Buffalo; and Clifford Murray, Huntington High School, Huntington.

The 1969 edition was written by Monroe Cravats, assistant professor of biology, New York City Community College, and Ann D. Muehleck, chairman, Science Department, Colonie Central School. William A. Calhoun, associate in science education, reviewed and analyzed the field test data which were used to establish the parameters for the 1971 edition.

Marvin Chanin, teacher of biology and chemistry at Francis Lewis High School, Flushing and Allan Lacey, teacher of biology at Benjamin Franklin High School, Rochester developed the new format which contains an extensive series of student laboratory and classroom activities designed to stimulate and develop the basic concepts of biological inquiry. Mr. Calhoun reviewed the developing syllabus and made valuable suggestions for inclusion.

Robert F. Zimmerman, associate in secondary curriculum, had general charge of the project and prepared the manuscript for publication.

Gordon E. Van Hooft
Director, Division of
School Supervision

1971 Revised Edition

Message to Teachers

This revised edition of the general biology syllabus is designed
student in a wide variety of creative experiences. Well developed stu
ternalize fundamental understandings when supported with appropriate f
oriented teaching, however, can only succeed with dynamic, innovative,

Ideas require direction, therefore, many important concepts are i
so that their implementation and reenforcement may proceed over the lo

Some topics, such as biochemistry, are deliberately not explored
necessarily limit the expansion of this material where feasible. Curr
throughout the course, providing students with relevant and meaningful

Some topics in the original syllabus have been omitted or condens
activities and projects and the use of multimedia materials. Time has
quizzes.

The Biology Supplement, a separate publication, contains a valuable
which can be used to enrich the learning experiences of this course.

Even though certain topics have been scheduled for particular par
flowers are scheduled in the spring), living material should be present
Aquaria, terraria, and potted plants should be in the room throughout
can be made of desert, swamp, and water habitats.

Abstract concepts such as homeostasis and assimilation have been
which develop these concepts within the parameters comprehended by a l
population have been included.

1971 Revised Edition

Message to Teachers

f the general biology syllabus is designed to involve the nonscience-oriented
creative experiences. Well developed student activities will help to in-
tandings when supported with appropriate facts. This kind of activity-
can only succeed with dynamic, innovative, teacher direction.

, therefore, many important concepts are introduced early in the school year
and reenforcement may proceed over the longest possible period of time.

ochemistry, are deliberately not explored in depth, but this should not
ion of this material where feasible. Current problems are investigated
ding students with relevant and meaningful learning experiences.

inal syllabus have been omitted or condensed to permit time for student
the use of multimedia materials. Time has been included for review and

a separate publication, contains a valuable list of multimedia materials
the learning experiences of this course.

ics have been scheduled for particular parts of the year (green plants and
spring), living material should be present in the classroom year around.
d plants should be in the room throughout the year. Biome representation
, and water habitats.

as homeostasis and assimilation have been deliberately omitted. Activities
within the parameters comprehended by a larger proportion of the student
d.

Awareness of the environment is stressed throughout the course.
and cyclic quality of life are presented in recurring and underlying

Organization of the Syllabus

The material in the syllabus is organized under two major headin

Column 1: UNDERSTANDINGS – presents the basic information
COLUMN IS SUBJECT TO TESTING. Recognition of te
is required. Vocabulary at student level is use

Column 2: ACTIVITIES – presents student laboratory experim
projects, and topics for discussion. ACTIVITIES
STANDINGS ARE TESTABLE IN THE PART II OPTIONS OF

The APPENDIX mentioned in the ACTIVITIES column provides teacher
and methods which have proven of value to other teachers.

Sequence and Scheduling

The units of this syllabus may be modified,but, for purposes of
sequence should not be changed. Since the sequence of units differs
comments are particularly significant and you are invited to use and
cluded at the end of each unit.

Five 45-minute periods per week for the school year is the minim
General Biology should be taught in a laboratory-classroom.

ent is stressed throughout the course. The interrelationship, complexity,
presented in recurring and underlying themes.

Organization of the Syllabus

bus is organized under two major headings:

DINGS – presents the basic information for the student. MATERIAL IN THIS
SUBJECT TO TESTING. Recognition of terms, not memorization or retrieval,
ed. Vocabulary at student level is used in this column.

S – presents student laboratory experiments, demonstrations, special
and topics for discussion. ACTIVITIES THAT DIRECTLY SUPPORT THE UNDER-
ARE TESTABLE IN THE PART II OPTIONS OF THE FINAL EXAMINATION.

the ACTIVITIES column provides teachers with supplementary information
of value to other teachers.

Sequence and Scheduling

s may be modified, but, for purposes of this field test evaluation, the
. Since the sequence of units differs from previous syllabuses, teacher
ificant and you are invited to use and mail in the evaluation sheet in-
.

r week for the school year is the minimum time recommended for this course.
ht in a laboratory-classroom.

State diploma credit

This course may be used for one unit of Group III credit as an e
Regents High School Diploma. THIS COURSE MAY NOT BE USED FOR CREDIT
EQUENCE.

Evaluation

A tear-out sheet has been provided at the end of each unit. It
teachers, if each teacher using the syllabus would take a few minutes
it to the **science office** of the Education Department.

be used for one unit of Group III credit as an elective toward a New York State Diploma. THIS COURSE MAY NOT BE USED FOR CREDIT AS PART OF A GROUP II MAJOR SCIENCE

t has been provided at the end of each unit. It will be of help to students and to acher using the syllabus would take a few minutes to evaluate each unit and return fice of the Education Department.

Supplementary Supplies and Materials

This list includes materials not usually found in a high school laboratory.

Unit 1

- Pond water containing algae
- Hay infusion
- Onions
- Elodea (may be obtained from local aquarium and tropical fish dealers)
- Bracket fungus or mushrooms showing hyphae
- Variety of potted plants (e.g., geranium, coleus, sansevieria)
- Supply of stiff paper (e.g., cardboard folders and colored paper)
- Unsalted crackers
- Lichens (reindeer moss)
- Legumes with nodules (e.g., clover-alfalfa)
- Nutrient agar
- Petri dishes
- Antibiotic paper dots
- Cakes of live yeast
- Fertilizer (decomposed manure)
- Insecticides
- Heavy petroleum oil

Unit 2

- Hard boiled eggs
- Large live earthworms
- Dissecting equipment
- Goldfish in an aquarium
- Prepared blood slides
- Empty vaccine bottles, with directions for use (from school physician)
- Examples of animal joints from slaughter houses (or use whole uncooked chicken)
- Sheep brain, preserved

Copper shavings
Concentrated nitric acid
Concentrated ammonia water

Unit 3

Fertilized chicken eggs
Blood grouping kit (with sterile single use lancets)
Frogs, preserved (male and female) (ideally, one for each student)

Unit 4

Tomato or other seedlings in nursery flats
Small flower pots with saucer bases
Radish seeds
Glass plates (3" x 3")
Peat moss
Section of tree trunk
Prepared slides of leaf cross section
Dead honeybees
Wide variety of flowers
Photomicrographs of pollen grains
Cuttings with developed roots (allow 4 weeks of growth). African v
work well.

Unit 5

Examples (alive if possible), of protozoa, arthropods (including Cr
chordates (fish, bird, amphibia, and reptile)
Samples of fossils including local types

ncid
water

ggs
with sterile single use lancets)
le and female) (ideally, one for each student)

lings in nursery flats
th saucer bases

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k
eaf cross section

ers
pollen grains
ped roots (allow 4 weeks of growth). African violets, geranium, coleus,

ossible), of protozoa, arthropods (including Crustaceans and insects), and
ird, amphibia, and reptile)
ncluding local types

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TOPIC OUTLINE

UNIT 1 - Introduction - Life Functions (Suggested time: 35

I. Characteristics of living things
II. Photosynthesis
III. Biochemistry of life
IV. Ecology
V. Water pollution

UNIT 2 - Systems of the Human Body (Suggested time: 60

I. Digestive system
II. Transport system
III. Respiratory system
IV. Locomotive system
V. Nervous system
VI. Excretory system

*With time allotted for quizzes evaluation, reorganization, an examination.

UNIT 3 - Continuation of Life (Suggested time: 45

I. Genetics
II. Sexual reproduction
III. Control of Disease

UNIT 4 - The Green Plants (Suggested time: 20

I. Environmental needs of plants
II. Sexual reproduction
III. Asexual reproduction
IV. Plant products

UNIT 5 - Classification and Evolution (Suggested time: 20

I. Classification
II. Evolution

TOPIC OUTLINE

		Understanding Number
ife Functions	(Suggested time: 35 days)*	1-3
of living things		4-9
		10-12
life		13-23
		24-28
Human Body	(Suggested time: 60 days)*	29-34
m		35-44
m		45-49
tem		50-52
em		53-57
		58-65
em		
f Life	(Suggested time: 45 days)*	66-82
		83-105
ction		106-109
ease		
ts	(Suggested time: 20 days)*	110-116
needs of plants		117
uction		118-120
duction		130
s		
n and Evolution	(Suggested time: 20 days)*	131-135
n		136-139

*With time allotted for quizzes, semester evaluation, reorganization, and State examination.

EXPANDED TOPIC OUTLINE

UNIT 1 - Introduction - Life Functions

I. Characteristics of living things
   1. Animal cell characteristics
   2. Plant cell characteristics

II. Photosynthesis

III. Biochemistry of life
   1. Respiration
   2. Diffusion
   3. Synthesis

IV. Ecology
   1. Food webs
   2. Symbiotic relationships
   3. Cycles
   4. Action of decomposers
   5. Bacteria
   6. Fermentation

V. Water pollution
   1. Sewage treatment
   2. Manmade water pollutants
   3. Recycling

UNIT 2 - System

I. Digest
   1. Fo
   2. Di
   3. Pr
   4. Ab

II. Transp
   1. He
   2. He
   3. Pa
   4. Im

III. Respir
   1. Ox
   2. Ai

IV. Locomo
   1. En
   2. Mu
   3. Na

V. Nervou
   1. Pa
   2. St

EXPANDED TOPIC OUTLINE

UNIT 2 - Systems of the Human Body

I. Digestive system

1. Food types
2. Digestive process
3. Protein synthesis
4. Absorption

II. Transport system

1. Heart function
2. Heart disease
3. Parts of the blood
4. Immunization

III. Respiratory system

1. Oxygen absorption
2. Air pollution

IV. Locomotive system

1. Energy requirement
2. Muscle fatigue
3. Nature of bones, muscles, and joints

V. Nervous system

1. Parts of the nervous system
2. Stimuli and sense organs

VI. Excretory system

1. Liver functions
2. Nitrogen excretion
3. Kidney - active transport
4. Skin as an excretory organ

UNIT 3 - Continuation of Life

I. Genetics

1. Sperm and egg
2. Mitosis
3. Meiosis
4. Fertilization
5. Dominant and recessive traits
6. Blended inheritance
7. Sex determination
8. Sex-linked traits
9. Multiple alleles
10. DNA - a coded molecule

II. Sexual reproduction

1. Fertilization
2. Courtship behavior
3. Parental care
4. Hormone control of reproductive cycles
5. Reproductive function - male
6. Menstrual cycle

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excretion
active transport
an excretory organ

of Life

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and recessive traits
inheritance
rmination
ed traits
alleles
coded molecule

duction

ation
p behavior
care
control of reproductive

tive function - male
l cycle

7. Embryonic development
8. Twinning
9. Gestation period
10. Birth

III. Control of disease

1. Symptoms
2. Dangers
3. Treatment

UNIT 4 - The Green Plants

I. Environmental needs of plants

1. Roots and water absorption
2. Cambium and growth
3. Leaf functions

II. Sexual reproduction

1. Flower parts
2. Pollination and fertilization

III. Asexual reproduction

1. Cuttings, runners, bulbs
2. Genetic implications

IV. Plant products

UNIT 5 - Classification and Evolution

I. Classification

1. Need of a universal system
2. Nature of phyla

II. Evolution

1. Modern evolution

a. Mutation
b. Natural selection
c. Random vs. nonrandom mating
d. Effects of isolation

2. Evidences of evolution

a. Fossils
b. Vestigial organs
c. Comparing embryos and skeletons

3. The evolution of man

GENERAL BIOLOGY — BEHAVIORAL OBJECT

At the completion of this course in general biology, a student should

1. construct statements based upon his personal observation th of properties of an object.
2. write statements of his observations in quantitative terms.
3. distinguish between observations and inferences.
4. identify observations that support an inference.
5. construct one or more inferences from a set of observations
6. describe in writing, a sequence of events constituting an i method, materials, procedure, and results.
7. identify and name observable properties in a set which coul objects.
8. construct a single-stage, or multistage classification of observable characteristics on which the classification is b
9. construct two or more different classification schemes for scheme serving a different purpose.
10. construct an operational definition based on a classificati
11. demonstrate his understanding that man must use his natural manner.

5

GENERAL BIOLOGY — BEHAVIORAL OBJECTIVES

this course in general biology, a student should be able to:

tatements based upon his personal observation that describe observable changes
es of an object.

ments of his observations in quantitative terms.

between observations and inferences.

servations that support an inference.

ne or more inferences from a set of observations.

writing, a sequence of events constituting an inquiry which includes the purpose,
erials, procedure, and results.

d name observable properties in a set which could be used to classify specific

single-stage, or multistage classification of a set of objects and name the
characteristics on which the classification is based.

wo or more different classification schemes for the same set of objects — each
ing a different purpose.

n operational definition based on a classification system.

his understanding that man must use his natural resources in a wise and effective

12. demonstrate his understanding of the social function of sc

13. identify examples of his environment that illustrate that:

- The sun is the major source of energy which drives
- Energy is lost as it flows through biological syst
- Biological systems attempt to maintain a state of
- Many natural processes reflect cyclical changes.
- Changes or events reflect interactions between phy of the environment.
- The study of the present environment may be used t
- Powers of observation are limited by the senses, a instruments.

understanding of the social function of science.

es of his environment that illustrate that:

is the major source of energy which drives biological systems.

is lost as it flows through biological systems.

cal systems attempt to maintain a state of dynamic equilibrium.

tural processes reflect cyclical changes.

or events reflect interactions between physical, chemical, and biological aspects environment.

dy of the present environment may be used to predict the future.

of observation are limited by the senses, and can be extended by the use of ents.

GENERAL BIOLOGY

UNIT 1

PROCESSES OF LIFE

UNDERSTANDINGS

INTRODUCTION:

1. Biology is the study of life. Living organisms have the following characteristics in common:

   - getting food: living things must have an energy source
   - breathing: taking in air
   - moving: to get food and escape enemies
   - excretion: getting rid of wastes
   - reacting to stimuli: changes due to the environment
   - synthesis: manufacturing substances
   - growth: increase in size and perhaps number of cells
   - reproduction: the ability to reproduce

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1.5 Obse

7

NDINGS	ACTIVITIES
f life. Living lowing character-	1.0 Illustrate with a variety of living things, e.g., plants, photos of microorganisms, insects, and other available forms.
iving things must ource	1.1 Using the organisms from 1.0, ask the students to chart the life activities that they have in common. The chart could have a list of organisms along one edge and a list of activities along the top. Which activities occur in <u>all</u> of the organisms?
ng in air food and escape	
ing rid of wastes	1.2 Observe pond water containing a variety of algae and unicellular organisms (point out algae as a producer).
uli: changes due nt	1.3 Demonstrate proper microscope technique.
facturing substances	1.4 Observe a hay infusion under a microscope. Draw paramecia or other protozoa. (Emphasize their ability to obtain food.)
e in size and perhaps	1.5 Observe reproducing cells of yeast or molds.
he ability to reproduce	

UNDERSTANDINGS

2.	Most animal cells, including the cells of man, have an outer boundary or cell membrane, a nucleus, and the watery cell fluid.	2.0 Obse obje stai
3.	Plant cells have a stiff outer layer (limiting their movement) called the cell wall, a cell membrane, a nucleus, and many have chloroplasts in their cell fluid.	3.0 Obse chlo
		3.1 Stud fere cell
		3.2 Elic migh
		3.3 (Opt obta
4.	The sun is the primary source of energy for living things.	4.0 Show plan
5.	Photosynthesis is the process of changing carbon dioxide and water into energy-storing compounds, (e.g., sugar) using light, chlorophyl, and enzymes.	5.0 Plac dark
		5.1 Grow stag chlo

NDERSTANDINGS	ACTIVITIES
ls, including the cells of ter boundary or cell membrane, he watery cell fluid.	2.0 Observe cheek cells, under the high power objective of the microscope. Use iodine to stain the nucleus.
e a stiff outer layer (limit- ent) called the cell wall, a a nucleus, and many have their cell fluid.	3.0 Observe onion and elodea cells (point out chloroplasts) under the microscope. 3.1 Students should list similarities and differences between typical plant and animal cells. 3.2 Elicit from students how green plant cells might meet food requirements. 3.3 (Optional) Ask how nongreen plants (fungi) obtain food.
primary source of energy for	4.0 Show examples of phototropisms using green plants in the classroom.
is the process of changing and water into energy- ds, (e.g., sugar) using yl, and enzymes.	5.0 Place a small sample of pond water algae in a dark place to show chlorophyl breakdown. 5.1 Grow bean seeds in darkness to the sprouting stage. Then move them into light. (Note chlorophyl production.)

UNDERSTANDINGS

A simplified formula for photosynthesis is:

$$6CO_2 + 6H_2O \xrightarrow[\text{chlorophyl}]{\text{light}} C_6H_{12}O_6 + 6O_2$$

6. The green plant produces sugar from CO_2 and H_2O. Sugar is energy in stored form.

7. Oxygen gas is a surplus product of photosynthesis. Most organisms, especially animals, depend on this oxygen for respiration.

8. All food stuffs are sources of energy and can be traced back to green plants which get their energy from the sun.

5.2 Demonstra
(See appe

Note: Th
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6.0 Compare s
sugar cub
while hol
tos plate
when igni

7.0 Build a s
snail and
near a li

8.0 Have stud
plants.
sugars an

8.1 Burn food
Discuss d
respirati

8.2 Compare b
running i

STANDINGS	ACTIVITIES
for photosynthesis is:	5.2 Demonstrate the building of a glucose molecule. (See appendix for details.)
—— $C_6H_{12}O_6 + 6O_2$	Note: This procedure may be adapted to show protein synthesis.
y!	
nergy in stored form.	6.0 Compare salivas (club soda) and sugar. Burn a sugar cube after dipping it in cigarette ashes while holding it with forceps. Place an asbestos plate underneath. Tilt the Bunsen burner when igniting the sugar; try to burn seltzer.
lus product of photo- anisms, especially his oxygen for res-	7.0 Build a self-sustained ecosystem using a snail and algae in a closed test tube, placed near a light source.
sources of energy and o green plants which n the sun.	8.0 Have students bring in samples of foods from plants. Use food tests to show they contain sugars and starches.
	8.1 Burn food from 8.0 such as peanuts or bread. Discuss differences between combustion and respiration.
	8.2 Compare breathing rates - sitting, and after running in place for 2 minutes.

9

UNDERSTANDINGS	ACTIVITI
9. When sugar is broken down and combined with oxygen, energy is released, leaving behind low energy molecules of CO_2 and H_2O.	9.0 Have students make ou cules by using the cu molecular shape. Sho apart upon addition o for details.)
	9.1 Fill test tubes with water covered with a Invert the tubes in a a color indicator (Be show that sugar molec
10. The movement of molecules from a place of high concentration to a place of low concentration is called diffusion.	10.0 Have students draw a outline of a cell (ce several glucose cutou sugar leaves the cell the membrane. (See a
	Have students suggest glucose molecules may "cell."
11. Molecules are retained in the cell if they are too big to fit through the membrane openings. The linking of sugar molecules into a long chain of starch is an example of synthesis for storage.	

DINGS	ACTIVITIES
own and combined with ased, leaving behind CO_2 and H_2O.	9.0 Have students make outlines of glucose molecules by using the cutout models of the molecular shape. Show that the molecule falls apart upon addition of oxygen. (See appendix A for details.)
	9.1 Fill test tubes with solution of sugar and water covered with a semipermeable membrane. Invert the tubes in a water bath containing a color indicator (Benedict's solution) to show that sugar molecules leave the tube.
les from a place of place of low con-ffusion.	10.0 Have students draw a page sized "porous" outline of a cell (cell membrane). Draw several glucose cutouts to illustrate how sugar leaves the cell through "holes" in the membrane. (See appendix and 9.0.) Have students suggest a way in which the glucose molecules may be retained by the "cell."
in the cell if through the linking of long chain of synthesis for	

UNDERSTANDINGS

12. Large complex molecules must be digested for transport or for use within the cell.	12.0 Have unti sali
	12.1 Use mine and the
13. Food webs begin with producers (green plants) which are eaten by consumers (such as animals).	13.0 Have ulti
14. Consumers are of three types, those which eat plants (herbivores), those which eat animals (carnivores), and those which eat both (omnivores).	
15. Certain close relationships may exist between organisms. Parasitism: one organism benefits (the parasite) while the other (the host) is harmed. Mutualism: both organisms benefit from this relationship.	15.0 Stud have rats mice 15.1 Have as m 15.2 Demo bact micr

STANDINGS	ACTIVITIES
cules must be digested or use within the cell.	12.0 Have each student chew an unsalted cracker until it tastes sweet. (Shows action of salivary enzyme.)
	12.1 Use iodine and Benedict's solution to determine the starch and sugar content of chewed and unchewed soda crackers. Make a chart of the results.
h producers (green eaten by consumers	13.0 Have students explain why all animals are ultimately dependent upon green plants.
ree types, those which ores), those which eat s), and those which eat	
ionships may exist be-	15.0 Student reports on other organisms which have benefited from human society, such as rats, cockroaches, squirrels, deer, sparrows, mice. . .
rganism benefits (the ite) while the other host) is harmed.	15.1 Have students give examples of parasites such as mosquitoes, viruses, worms.
rganisms benefit from elationship.	15.2 Demonstrate lichens and nitrogen fixing bacteria by use of a stereomagnifier and a microscope.

UNDERSTANDINGS

16.	Cycles exist in nature which permit certain elements to be used and reused (e.g., the nitrogen, carbon, hydrogen, and oxygen cycles).	16.0 Diag wast nitr Note
17.	Energy is lost in each step from producer to consumer.	17.0 Elic of p e.g.
		17.1 Pupi pond food

ANDINGS

re which permit certain
and reused (e.g., the
drogen, and oxygen

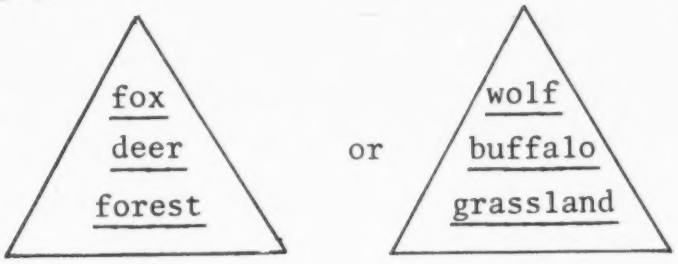
ch step from producer

ACTIVITIES

16.0 Diagram of sun - plants - animals - death - waste products - to show cycling of CO_2, O_2, nitrogen, and water. (See appendix for details.)

Note: You might also have interested students make a bulletin board or charts, using pictures.

17.0 Elicit from students relationships of biomass of producers and consumers in typical biomes, e.g.,



17.1 Pupil reports on a field trip to a forest, pond, meadow, or seashore to elaborate on food pyramids.

UNDERSTANDINGS	
18. Organisms such as bacteria and molds complete molecular cycles by returning important elements to green plants by way of the soil and water. We call these vital organisms decomposers. They are responsible for the formation of humus, or rich topsoil, which holds water, and gradually releases minerals needed for the growth of green plants.	18.0 Demonstra as compar 18.1 Pass arou Allow it and the c 2 days. 18.2 Optional: build a c and plac 18.3 Have stud it to san
19. Decomposers living under crowded conditions must compete for water, food, and space. They produce poisons (toxins) which limit the encroachment on their living space by other organisms.	19.0 Grow bact Possible dust, fin and bread Note: Re co to 19.1 Grow bact Point out closed an Note: Us bi

UNDERSTANDINGS	ACTIVITIES
ch as bacteria and molds ecular cycles by returning ements to green plants by oil and water. We call organisms decomposers. They ble for the formation of ch topsoil, which holds radually releases minerals he growth of green plants.	18.0 Demonstrate water holding capacity of humus as compared to sand. 18.1 Pass around small amounts of fresh hamburger. Allow it to set exposed. Observe mold growth, and the change in odor of the hamburger after 2 days. 18.2 Optional: Using table scraps have students build a compost pile in an open plastic bag and place outdoors. 18.3 Have students smell and handle humus. Compare it to sand or dirt.
living under crowded con- compete for water, food, They produce poisons (toxins) the encroachment on their by other organisms.	19.0 Grow bacteria and mold on nutrient agar. Possible sources: pond water, humus, air, dust, fingernail scrapings, decaying food, and bread mold. Note: Record growth patterns, and signs of competition. Keep plates long enough to show aging and death. 19.1 Grow bacteria and mold on the same agar plate. Point out rings of inhibition. Keep plates closed and dispose of them carefully. Note: Use paper dots saturated with antibiotics and use for a bioassay.

UNDERSTANDINGS	
20. Most bacteria require oxygen, food, and water.	
21. When large numbers of bacteria are placed in water the small amount of oxygen that is normally available is drastically reduced.	21.0 Slowly heat cubes. Note the side. open contai 21.1 Briefly dis 21.2 Plan a fiel
22. Some types of bacteria and molds do not require oxygen to release energy from food.	22.0 Give each l cider (no p yeast. Cor mentation f
23. Fermentation, which does not use oxygen, releases less energy than oxygen respiration, because the food molecules are not completely broken down. Poisonous fragments such as alcohol and lactic acid are produced.	23.0 Have studen glucose mol out how alc
24. When streams, rivers, or lakes are robbed of oxygen, fermentation takes place. The poisons produced are serious pollutants.	24.0 Have studen Bring in sa 24.1 Show movies effects of

NDERSTANDINGS	ACTIVITIES
equire oxygen, food, and	
bers of bacteria are placed mall amount of oxygen that ilable is drastically re-	21.0 Slowly heat a clear mixture of water and ice cubes. Note the bubbles of oxygen forming on the side. (This also might be related to an open container of carbonated water.) 21.1 Briefly discuss thermal pollution. 21.2 Plan a field trip to a suwage disposal plant.
bacteria and molds do not to release energy from	22.0 Give each lab group a small amount of apple cider (no preservative added) and add living yeast. Cork loosely. Observe signs of fermentation for several days.
which does not use oxygen, energy than oxygen respir- the food molecules are not ken down. Poisonous frag- lcohol and lactic acid are	23.0 Have students suggest what happens to the glucose molecule during fermentation. Point out how alcohol and lactic acid are produced.
rivers, or lakes are robbed mentation takes place. The ed are serious pollutants.	24.0 Have students photograph polluted water. Bring in samples of polluted water. 24.1 Show movies, filmstrips, and slides of the effects of water pollution.

UNDERSTANDINGS

25. Water pollution can be diminished by proper treatment of sewage and by use of biodegradable detergents.

26. Other manmade wastes such as oil, phosphates, nitrates, DDT, and runoff from farmlands are increasing water pollution.

27. Some manmade solid wastes cannot be recycled by decomposers.

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24.1 Show

24.2 Show

24.3 Discu
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27.0 Have
bottl
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15

STANDINGS	ACTIVITIES
be diminished by sewage and by use tergents.	25.0 Discuss the operation of a modern sewage plant.
	25.1 Bring in samples of completely decomposed manure. (Use for fertilizer)
s such as oil, , DDT, and runoff increasing water	26.0 Pass out lists from supermarkets detailing the phosphate contents of common household detergents. Have students report on the phosphate content of detergents used in their homes. Note: Dishwasher detergents containing phosphates are extremely alkaline.
	26.1 Show samples of crude oil or fuel oil.
	26.2 Show pictures of oil-soaked water fowl.
	26.3 Discuss effects of DDT on foodwebs. (How would you throw away a container of DDT?)
wastes cannot be ste.	27.0 Have students bring in samples of old plastic bottles, cans, and glass bottles to illustrate their resistance to biodegradation.

UNDERSTANDINGS

28. Most solid waste can be recycled or at least decreased in volume.	28.0 Crush a tin c and label. C can. Emphasi waste volume.
	28.1 If recycling area have stu the dubious v Have students and periodica able bottles.

GS

ACTIVITIES

ecycled or at
.

28.0 Crush a tin can after removing top, bottom, and label. Compare decreased volume to whole can. Emphasize importance of decreasing waste volume.

28.1 If recycling centers do not exist in your area have students try to start one. Discuss the dubious value of compactors for garbage. Have students press for pickup of newspapers and periodicals, and the purchase of returnable bottles.

16

GENERAL BIOLOGY EVALUATION SHEE

Teacher's Name_____ School_____

School Address_____

Evaluation for Unit 1

Which activities did the students find most valuable? Which were least valuable?

Which understandings did you find interesting to teach? Which understandings did you consider the least significant?

Comments: [You may continue on the reverse side.]

17/18

GENERAL BIOLOGY EVALUATION SHEET

_____ School_____ Date_____

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ients find most
valuable?

find interesting to
did you consider

on the reverse side.]

Number of students in each class of

General Biology _____ _____

_____ _____ _____

Years of teaching experience:

Biology _____

General Science 7, 8, or 9 [check]

_____

General Biology _____

Other [identify] _____

RETURN TO:

Mr. William Calhoun
Science Education Office
State Education Department
Albany, N.Y. 12224

17/18

UNIT 2

SYSTEMS OF THE HUMAN BODY

UNDERSTANDINGS

29. Man uses a variety of food types, such as: 29.0

- carbohydrates (sugars and starches) which are sources of energy 29.1
- fats which are sources of concentrated energy
- proteins which provide building material
- vitamins which are necessary for enzyme activity
- minerals which are inorganic substances necessary to maintain life
- water which is the primary solvent in the body

30. Complex foods cannot be used until they are digested. 30.0

19

ODY

RSTANDINGS

ACTIVITIES

of food types, such as:

s (sugars and starches)
ources of energy

re sources of concentrated

ich provide building

ich are necessary for
vity

ich are inorganic sub-
ssary to maintain life

is the primary solvent

not be used until they

29.0 Have students bring in food samples and test them for the presence of proteins, starches, sugars, and fats.

29.1 Place samples of fatty and starchy foods in water to show their lack of solubility.

30.0 Have students attempt to digest egg protein.

UNDERSTANDINGS

31. Proteins are essential for cell and tissue growth and repair.

32. Most of man's body (including muscle, tendons, cartilage, skin, enzymes, and hair) is made of proteins which are synthesized from previously digested protein.

33. Man's digestive system contains a series of specialized organs which form a tube. Its function is to simplify food into small diffusable molecules.

Each
test t

Drop
white

Discus
relati

32.0 Dissec
tube w

Note:

ACTIVITIES

Each laboratory group should have four test tubes 1/4 full of water.

1st tube - water
2d - water + dil. HCl
3d - water + pepsin
4th - water + pepsin + HCl

Drop a very thin slice of hard-boiled egg white into each tube.

Discuss the specificity of enzymes and their relationships to temperature and pH.

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igested

ns a series
orm a tube.
ood into

32.0 Dissect an earthworm and compare its digestive tube with the digestive system of man.

Note: Review synthesis and hydrolysis. The use of paper models is recommended.

20

UNDERSTANDINGS

34. The rate at which digested molecules diffuse into the bloodstream is dependent upon the surface area of the small intestine and the chemical concentration level of the blood.

34.0 Show
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seve
(Rel

Note

TRANSPORT SYSTEM

35. As the digested food materials diffuse out of the small intestine, the blood transport system distributes the nutrients along with other vital materials to all parts of the body.

35.0 Have
the

36. The heart contractions pump blood through many miles of vessels, adjusting the rate and pressure to body requirements.

36.0 Demo
the

36.1 Have
Expl
bloo

36.2 Test
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plac
rate

21

ANDINGS	ACTIVITIES
gested molecules dif- tream is dependent a of the small intes- l concentration level	34.0 Show how a surface area of limited dimension may be increased by folding a piece of paper several times into an accordion-like shape. (Relate surface area to villi.) Note: This may also be applied to the lung surface (alveoli) and the outer surface of the cerebrum.
l materials diffuse out ne, the blood trans- tes the nutrients along erials to all parts of	35.0 Have students discuss how nutrients get into the cell, and how they may be used.
ns pump blood through s, adjusting the rate requirements.	36.0 Demonstrate goldfish tail or frog's web under the microprojector to show circulation. 36.1 Have students find their pulse in the wrist. Explain that the pulse is the movement of blood in an artery. 36.2 Test pulse rate under various activity levels – while seated, when standing, after running in place. (Recall the activity on breathing rates.)

UNDERSTANDINGS

37. The heart beat rate is variable and increases in order to supply the working muscles with the sugar and oxygen that they need.

38. Unlike other muscles in the body, the heart is in continual use, relaxing only between beats. The addition of stressors such as being overweight, having poor muscle tone, emotional stress, smoking, and air pollution may lead to premature heart failure.

39. Special nerve pathways enable the heart muscle to contract or relax at a rhythmic, coordinated pace. Blood clots in coronary arteries may interfere with nerve transmission, and can lead to sudden death.

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37.1 Have a st
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substance

38.0 Discuss h

ACTIVITIES

iable and in-
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oxygen that

37.0 Have students discuss circulatory malfunctions due to constricted arteries or malfunction of the valves in the veins.

37.1 Have a student squeeze a rubber ball and hold it. Discuss the resulting muscle fatigue. Relate this to oxygen deprivation, anaerobic respiration, and the production of poisonous substances.

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having poor
ess, smoking,
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38.0 Discuss heart disease.

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lots in coronary
h nerve trans-
udden death.

UNDERSTANDINGS

40. Blood tissue is composed of diverse materials such as:

- fluid solution — which transports dissolved materials and blood cells, and helps control body temperature.
- red blood cells — which carry oxygen.
- white blood cells — which aid in controlling disease by ingesting bacteria or by synthesizing protective enzymes.
- platelets — which initiate blood clot formation.

41. The blood produces special proteins, called antibodies, which protect us against foreign proteins.

42. Highly toxic proteins are produced by some parasitic viruses and bacteria.

40.0 Observ

40.1 Constr
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shapes

40.2 Optio

41.0 Relat
organ

42.0 Discu

42.1 Discu
child

NDERSTANDINGS

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s control body temperature.

d cells – which carry

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or by synthesizing
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uces special proteins,
ies, which protect us
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roteins are produced by
viruses and bacteria.

ACTIVITIES

40.0 Observe blood slides and note cell types.

40.1 Construct red blood cell models (half dollar size) using red nonsetting clay. Use string and a cm. ruler to compute surface area. Compare the area to that of ball, disc, and donut shapes made with the same amount of clay.

40.2 Optional: Discuss leukemia.

41.0 Relate back to the competition of soil organisms.

42.0 Discuss Clostridium botulinum.

42.1 Discuss student experiences with typical childhood diseases.

UNDERSTANDINGS	ACTI
43. Innoculations help to protect us against invading organisms. • Active immunity: innoculation of weakened germ, dead germ, or a weakened toxin activates the production of protective antibodies. Active immunization has a long lasting effect. • Passive immunity: innoculation of antibodies from another organism's blood to fight foreign proteins. Passive immunization usually has an immediate but short term effect.	43.0 Discuss students and their effect
44. Vaccines immunize by initiating antibody production. They are specific and usually require time to produce immunity.	44.0 Discuss tetanus a recommended when sustained.
RESPIRATORY SYSTEM	
45. The respiratory system provides the human blood tissue with oxygen.	45.0 Recall (or repeat

TANDINGS	ACTIVITIES
to protect us against	43.0 Discuss students experiences with vaccines and their effect on the body.
ty: innoculation erm, dead germ, or xin activates the protective anti- ve immunization sting effect.	
ity: innoculation from another ood to fight foreign ssive immunization n immediate but short	
y initiating antibody re specific and e to produce immunity.	44.0 Discuss tetanus antitoxin, and why it is recommended when deep wounds have been sustained.
tem provides the with oxygen.	45.0 Recall (or repeat) the breathing rate activity.

UNDERSTANDINGS

45.1	Hav gol moi nec pro
46. Oxygen in the air sacs of our lungs passes through the thin, moist membranes into the blood.	46.0 Blo moi Are
	46.1 Exa stu
47. Foreign material (from smoking and air pollution) tends to inhibit the diffusion of oxygen into the blood.	47.0 Bur the moi
	Hav the dep
	47.1 Dis smo
	47.2 Hav alv pol

NDERSTANDINGS	ACTIVITIES
	45.1 Have students examine the gill passages of a goldfish. Wrap the goldfish gills with a moist towel. Ask students why the towel is necessary. Ask how our respiratory tract is protected from drying.
ir sacs of our lungs passes n, moist membranes into the	46.0 Blow up a dry brown paper bag. Thoroughly moisten the bag and try to blow it up again. Are the results the same?
	46.1 Examine living earthworms and/or frogs. Have students note their moist thin skin.
l (from smoking and air s to inhibit the diffusion the blood.	47.0 Burn a cigarette in a test tube, collecting the smoke in another test tube containing moist cotton. (See appendix for details.) Have students note the accumulation of tars on the walls of the test tube. What might tar deposits do to the air sacs of human lungs?
	47.1 Discuss the effects of air pollution and smoking on the lungs.
	47.2 Have a student draw a chart of a normal alveolus and one damaged by smoking or air pollution.

UNDERSTANDINGS

48. Air pollutants may be in the form of: 48.0 Disc loca

- gases—carbon monoxide, sulfur dioxide, nitrogen oxide.
- airborn particles — smoke, soot, dust, unburned fuels.

When air pollutants are mixed with water, affected by sunlight, and under temperature inversion, they form a smog which may hang in the air for several days.

49. Control of car exhaust and smokestack emission is essential if air pollution is to be minimized. 49.0 Prop two rese repr abat

LOCOMOTION SYSTEM

50. Muscle cells release stored energy when they do work. Oxygen and nutrients (sugar) must diffuse into these cells from the blood to replenish their energy supply. 50.0 Dist stud leav

ANDINGS	ACTIVITIES
in the form of: onoxide, sulfur en oxide. es — smoke, soot, fuels. re mixed with water, and under tempera- form a smog which or several days.	48.0 Discuss smog with particular emphasis on local problems.
t and smokestack emis- air pollution is to be	49.0 Propose a debate on pollution problems between two groups of students. The first group representing car manufacturers, the second representing citizens interested in pollution abatement.
stored energy when and nutrients into these cells lenish their	50.0 Distribute diagrams of muscle cells and have students indicate the materials entering and leaving the cell during respiration.

UNDERSTANDINGS

51. Muscle cells will continue to operate even if they do not receive sufficient oxygen. Under these conditions they produce lactic acid which causes fatigue.

52. Human movement depends upon the close interaction of bones, muscles, tendons, and properly articulated joints.

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DERSTANDINGS

11 continue to operate
not receive sufficient
these conditions they
acid which causes

depends upon the close
bones, muscles, tendons,
ticulated joints.

ACTIVITIES

52.0 Obtain and show examples of animal joints. Students can examine an articulated skeleton or a skeletal diagram and attempt to locate hinge, ball and socket, gliding, and fused joints.

52.1 Students might construct an articulated skeleton model from "bones" cut from a dittoed sheet.

52.2 Have students construct a model of a hinge joint with its muscle attachments. (See appendix for details.)

52.3 Have students wiggle their fingers when their arm is outstretched. Where are the muscles involved located? Can tendon movement be detected?

52.4 Have students place their hand on the desk with their middle finger folded under the palm. Which fingers lift easily? Which with difficulty? Which finger cannot be raised at all?

UNDERSTANDINGS	AC
NERVOUS SYSTEM	
53. The various systems of the body must be coordinated. This coordination is accomplished by the nervous and endocrine systems.	53.0 Give students a showing: stimu effectors. (Se
54. The parts of the central nervous system responsible for regulation are:	54.0 Show students m brain convoluti creased surface
• Spinal cord: lower reflexes and impulse transmission	54.1 Students workin eye pupil const covers his eyes other student m
• Brain	Note: Do not u
- Cerebrum: center of thinking, memory, emotions, sense organ interpretation, and voluntary activity	54.2 Discuss cerebra of resulting pa
- Cerebellum: coordination of muscles, center of balance	54.3 Discuss the tem drugs on the br
- Medulla: center of respiration, heart beat, and other non-voluntary activity	

TANDINGS	ACTIVITIES
of the body must be coordination is ac- ervous and endocrine	53.0 Give students a rexographed or dittoed chart showing: stimuli, senses, parts of brain, effectors. (See appendix for suggested chart.)
ntral nervous system ulation are:	54.0 Show students models of the brain. Point out brain convolutions and relate them to an increased surface area.
lower reflexes and mission	54.1 Students working in pairs can observe the eye pupil constriction reflex. One student covers his eyes, then opens them as the other student makes observations. Note: Do not use a very bright light source.
center of thinking, ions, sense organ ion, and voluntary	54.2 Discuss cerebral hemorrhage and the possibility of resulting paralysis.
coordination of nter of balance	54.3 Discuss the temporary and permanent effects of drugs on the brain - e.g., alcohol and LSD.
enter of respiration, and other non- ctivity	

UNDERSTANDINGS

55. A stimulus is a specific change in the environment to which our nervous system reacts.

56. Our sense organs receive stimuli such as light, sound, heat, cold, pain, odor, and taste, as well as muscle position and concentration of CO_2 in the blood.

56.0 Have stude
specific s

56.1 Have stude
sition of

57. The nervous system reacts to stimuli by directing the action of muscles and glands.

EXCRETORY SYSTEM

58. The cells which form body systems produce wastes which must be eliminated in order to maintain life.

58.0 Ask studen
not proper
or farm.

58.1 Ask studen
eliminated

59. Liver functions include the storage of sugar in the form of animal starch, the breaking down of many poisons in the blood (including alcohol), and the production of urea resulting from protein metabolism.

59.0 Show liver
torso mode

59.1 Fresh chic
for the p

ANDINGS	ACTIVITIES
fic change in the our nervous system	
eive stimuli such as old, pain, odor, muscle position CO_2 in the blood.	56.0 Have students suggest ways that stimuli affect specific sense organs. 56.1 Have students explain how they know the position of their limbs without looking at them.
eacts to stimuli by of muscles and	
body systems produce eliminated in order	58.0 Ask students what would happen if wastes were not properly disposed of in a home, factory, or farm. 58.1 Ask students to list the wastes that must be eliminated from the body.
ude the storage of animal starch, the poisons in the ohol), and the pro- lting from protein	59.0 Show liver size and location by dissecting a torso model of man. 59.1 Fresh chicken or beef liver can be tested for the presence of glycogen.

UNDERSTANDINGS

	Note: Mus ene
	59.2 Discuss th habitual u
60. Nitrogen is an essential part of the protein molecule.	60.0 Point out an amino a
61. Excess nitrogen compounds must be eliminated in order to maintain life. They must be excreted in a form that is not highly toxic, such as urea.	61.0 Place a sm concentrat students c wafting it directly.
	61.1 Have stude Note that
	61.2 Have stude H_2O and CO
62. The blood transport system carries metabolic wastes (excess H_2O, CO_2, excess salts, and urea) to filtration and diffusion areas where they are excreted.	62.0 List the p much water taking exc
	62.1 Does scien why people weather mi

30

ACTIVITIES

Note: Muscles also store glycogen for local energy release.

59.2 Discuss the relationship of liver damage to habitual use of alcohol.

60.0 Point out the nitrogen atom in a drawing of an amino acid.

61.0 Place a small piece of copper into a little concentrated HNO_3 in a test tube, and have students carefully smell the gas (NO_2) by wafting it towards them and not smelling it directly.

61.1 Have students carefully smell ammonia water. Note that it is a poisonous nitrogen compound.

61.2 Have students compare toxicity of NO_2 with H_2O and CO_2.

62.0 List the possible outcomes of drinking too much water, eating too much salt, or undertaking excessive exercise.

62.1 Does scientific or medical evidence indicate why people doing strenuous work during hot weather might take salt tablets?

UNDERSTANDINGS	
63. The kidneys remove urea and excess water from the blood, and reclaim most of the sugar and other vital substances which are returned to the blood.	63.0 Have studen resenting in the kidn
64. To reclaim sugar it is necessary to oppose the flow of normal diffusion. Energy must be used to "pump" the sugar back into the blood. This is called active transport.	64.0 Discuss why 64.1 Discuss the water in th
65. The skin and the lungs are sites of excretion for excess water, CO_2, and some salts.	65.0 Point out t in the cool

31/32

ANDINGS	ACTIVITIES
rea and excess water reclaim most of the l substances which blood.	63.0 Have students make a simplified diagram representing diffusion and active transport in the kidney.
is necessary to ormal diffusion. to "pump" the blood. This is ort.	64.0 Discuss why a diabetic has sugar in his urine. 64.1 Discuss the necessity for active transport of water in the protozoa.
gs are sites of water, CO_2, and	65.0 Point out the primary function of perspiration in the cooling of the body.

GENERAL BIOLOGY EVALUATION SHE

Teacher's Name _____ School _____

School Address _____

Evaluation for Unit 2

Which activities did the students find most valuable? Which were least valuable?

Which understandings did you find interesting to teach? Which understandings did you consider the least significant?

Comments: [You may continue on the reverse side.]

33/34

GENERAL BIOLOGY EVALUATION SHEET

_____ School _____ Date _____

_____

e students find most
east valuable?

d you find interesting to
dings did you consider

tinue on the reverse side.]

Number of students in each class of

General Biology _____ _____

_____ _____ _____

Years of teaching experience:

Biology _____

General Science 7, 8, or 9 [check]

_____

General Biology _____

Other [identify] _____

RETURN TO:

Mr. William Calhoun
Science Education Office
State Education Department
Albany, N.Y. 12224

GENERAL BIOLOGY

UNIT 3

CONTINUATION OF LIFE

UNDERSTANDINGS		
Genetics		
66. We inherit specific traits from our parents.	66.0	Elicit hair c attach
67. Inherited traits are not transmitted by the blood, but through the genetic material contained in sperm and egg.	67.0	Ask st
68. The sperm cell from the father is very small and primarily contains nuclear material. The egg from the mother is much larger and contains nutrient material for embryonic growth, although the nucleus is also very small.	68.0	Observ cells.
	68.1	Show c cells.
69. Genetic material in the form of chromosomes can be seen in dividing cells.	69.0	Use th of oni ments.
	69.1	Set up pared

INGS	ACTIVITIES
its from our	66.0 Elicit from students examples of traits, e.g., hair color, skin color, eye color, ear-lobe attachment, tongue rolling ability.
t transmitted by the genetic material egg.	67.0 Ask students how they inherit traits.
father is very tains nuclear the mother is s nutrient material though the nucleus	68.0 Observe prepared slides of frog egg and sperm cells. 68.1 Show charts and photographs of sperm and egg cells.
form of chromosomes cells.	69.0 Use the microprojector to show prepared slides of onion tips. Point out chromosome arrangements. 69.1 Set up demonstration microscopes with prepared slides of onion tips.

UNDERSTANDINGS

70.	Cells divide by a process called mitosis.	70.0 Use paper cu appendix.)
71.	In higher forms of life one set of chromosomes comes from the male, and one set comes from the female.	71.0 Show chart o human chromo out that we Compare huma chromosomes.
72.	The chromosome number does not double with each new generation, because it is reduced by one-half during meiosis.	72.0 Use paper cu ners should to show poss (Emphasize n chromosomes for details. Note: Point taini
73.	When the nuclei of two sex cells (egg and sperm) unite during fertilization the normal species number of chromosomes is restored.	
74.	Some traits are visible if present and are called dominant. (Usually designated by a capital letter.)	74.0 Point out Me (P_1, F_1, and

ANDINGS	ACTIVITIES	
ocess called mitosis.	70.0	Use paper cutouts to show mitosis. (See appendix.)
fe one set of chromo- male, and one set comes	71.0	Show chart or photomicrographs of the 46 human chromosomes arranged in pairs. Point out that we inherited 23 from each parent. Compare human chromosomes with fruit fly chromosomes.
does not double with because it is reduced iosis.	72.0	Use paper cutouts of chromosomes. Lab partners should have four chromosomes to show possible assortments after meiosis. (Emphasize necessity for half the number of chromosomes in sex cells.) (See appendix for details.) Note: Point out the necessity for maintaining chromosome number.
o sex cells (egg and ertilization the of chromosomes is		
le if present and (Usually designated	74.0	Point out Mendelian inheritance in pea plants. (P_1, F_1, and F_2 generation)

UNDERSTANDINGS

75.	Other traits, hidden by the dominant trait in a hybrid, are called recessive. They appear only when in the pure state. (Usually designated by two identical lower case letters.)	75.0	Have st are ton numbers is a do
		75.1	Illustr coins.
		75.2	Use Pun for ton
76.	Discrete portions of the chromosome which control traits are called genes.	76.0	Place l paper c
		76.1	Charts as pea should
77.	Not all characteristics show dominance. Instead, traits may be blended, e.g., blended color in 4 o'clock flowers, short-horned cattle, and Andalusian fowl.	77.0	Use cha Have st genetic e.g., e
78.	Sex in humans is determined by specific sex chromosomes. Males have XY chromosomes, females have XX chromosomes. The Y chromosome is smaller and does not have all the genes found on the X chromosome.	78.0	Have st sex, an occurs.
		78.1	Show ph somes i

ANDINGS	ACTIVITIES
by the dominant trait led recessive. They the pure state. by two identical	75.0 Have students determine whether or not they are tongue rollers. On the basis of class numbers try to decide whether tongue rolling is a dominant or recessive trait.
	75.1 Illustrate the laws of probability by tossing coins.
	75.2 Use Punnett squares to show possible crosses for tongue rolling trait.
the chromosome which called genes.	76.0 Place letters, representing genes, on the paper chromosomes used in activity 5.0.
	76.1 Charts showing traits in other species, such as pea plants, fruit fly, and guinea pigs, should be used to reinforce learning.
ics show dominance. e blended, e.g., blended lowers, short-horned an fowl.	77.0 Use charts to illustrate blended inheritance. Have students suggest blending in human genetics reminding them of its complexity, e.g., eye color and height.
ermined by specific les have XY chromo- XX chromosomes. The ler and does not have on the X chromosome.	78.0 Have students explain which parent determines sex, and at what instant that determination occurs.
	78.1 Show photomicrographs comparing X and Y chromosomes in humans and fruit flies.

UNDERSTANDINGS

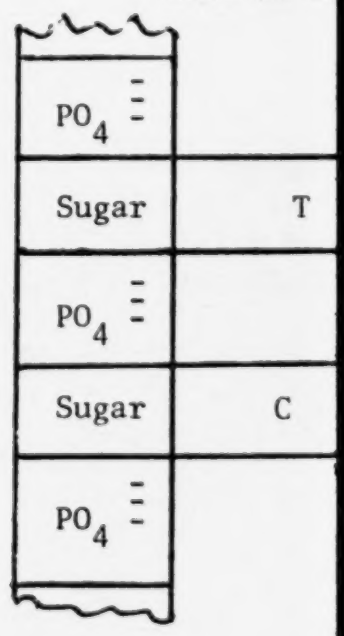
79. In females, if a defective gene is recessive and located on the X chromosome, the other X chromosome may mask the defective gene. However, the male with a defective gene on the X chromosome may not have it masked in this way. Sex-linked disabilities, e.g., hemophilia and color blindness, are influenced by the differences in X and Y chromosomes, and are more common in males.	79.0 Use test chart trate how we 79.1 Study Queen Vi 79.2 Propose the ma showing sex-li students deve possible resu show affected 79.3 Have students sex-linked cha three generati
80. Some traits are controlled by more than one gene. Multiple genes account for A, B, O, and AB blood groups.	80.0 Have students Note: Parenta consent sterile 80.1 Have students 80.2 Work out blood Punnett square blood have gr with group A b children.

GS

	ACTIVITIES
gene is the X chromo- ome may mask ver, the male the X chromo- ed in this way. e.g., hemophilia influenced by Y chromosomes, les.	79.0 Use test charts for color blindness to illustrate how we determine this abnormality.
	79.1 Study Queen Victoria's pedigree.
	79.2 Propose the marriages of various couples showing sex-linked characteristics. Have students develop Punnett squares showing possible results. (Suggestion: use x- to show affected chromosome.)
	79.3 Have students develop pedigree charts for sex-linked characteristics showing two or three generations.
d by more than account for ups.	80.0 Have students determine their blood group. Note: Parental consent and school board consent should be obtained, and sterile technique must be used.
	80.1 Have students discuss multiple gene traits.
	80.2 Work out blood group relationships using Punnett squares, e.g., parents with group O blood have grcup O children; parents with group A blood may have group A or O children.

UNDERSTANDINGS

81. The chromosomes and genes are theoretically composed of a coded molecule called DNA. This molecule has the ability to replicate itself and the ability to code RNA which controls protein synthesis.	81.0 Use availa structure
82. The DNA code is based upon four code units arranged in sets of two. A combines with T C combines with G	82.0 Distribute Have stude letters ar outline of number of used in u



RSTANDINGS

ACTIVITIES

nd genes are theoretically
ed molecule called DNA.
the ability to replicate
ility to code RNA which
synthesis.

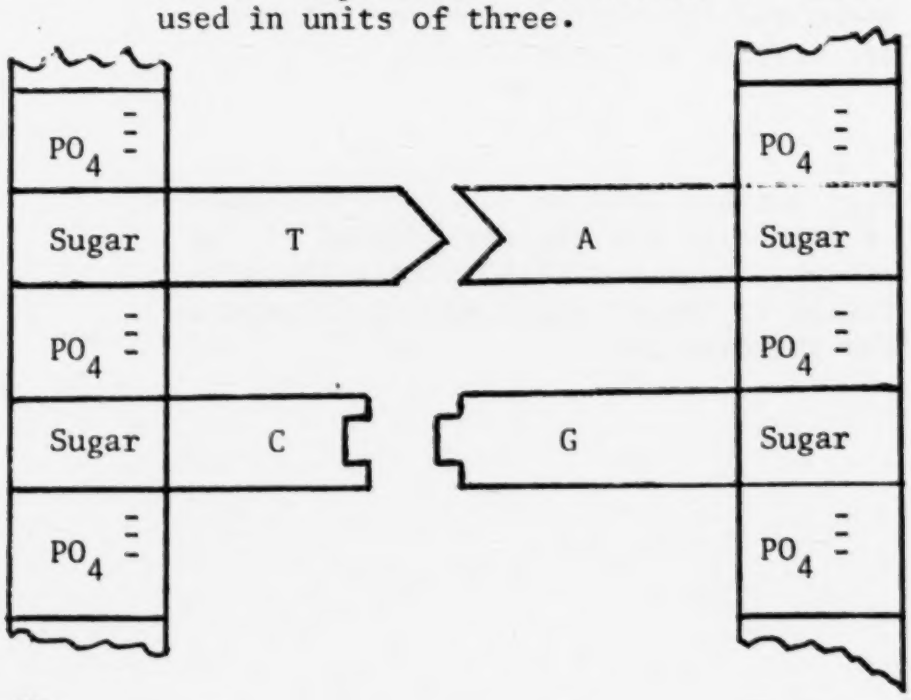
ased upon four code units
of two.

h T

h G

81.0 Use available models of DNA so the basic structure can be seen.

82.0 Distribute paper cutouts of nitrogen bases. Have students label them with appropriate letters and fit the bases together across the outline of a DNA molecule. Point out the large number of possible combinations if bases are used in units of three.



UNDERSTANDINGS	ACTIVITIE
	82.1 Test student knowledge out sheets with one si letter coded and the o students complete the
83. Reproduction is essential to species survival.	83.0 Point out the biologic essential to the survi contrasted with reprod sary for species survi
84. Sexual reproduction usually involves sperm and egg cells. Both cell types are fragile and short-lived.	84.0 Use films and film loo movement and fertiliza
	84.1 Discuss spawning of sa variety of fish.
85. Eggs contain yolk or some other source of nutrition for the development of the embryo. Eggs must also permit the diffusion of oxygen and oxidized substances for respiration.	85.0 Bring in a chicken egg external and internal yolk, membrane, and ai
	85.1 Incubate chicken or du lized egg gain or lose Note any change of mas
	85.2 Have students store tw or petroleum jelly cov limburger cheese or cu container in the refri open both eggs, and ha differences in their c

ACTIVITIES

82.1 Test student knowledge of coding by passing out sheets with one side of the DNA molecule letter coded and the other side blank. Have students complete the molecule.

species

83.0 Point out the biological functions that are essential to the survival of the individual contrasted with reproduction which is necessary for species survival.

involves
ell types

84.0 Use films and film loops to illustrate sperm movement and fertilization.

84.1 Discuss spawning of salmon or some local variety of fish.

her source
ment of the
it the dif-
d substances

85.0 Bring in a chicken egg. Make a drawing of external and internal appearance. (Point out yolk, membrane, and air space.)

85.1 Incubate chicken or duck eggs. Will a fertilized egg gain or lose mass during incubation? Note any change of mass each day.

85.2 Have students store two raw eggs (one with wax or petroleum jelly covering it) near some limburger cheese or cut onions in a closed container in the refrigerator. After one week open both eggs, and have students note differences in their odors.

UNDERSTANDINGS

86.	A study of the internal anatomy of frogs shows the location and spatial relationships of the organs necessary for reproduction.	86.0 Have stude tinguish female. out ovary Have stude relations 86.1 Have stude Try to get Note: Tak dit
87.	In many organisms courtship activities stimulate the partners previous to mating. The activities tend to be highly specific for the species. (Species recognition)	87.0 Use pictur ship among grunion, e salmon, ap stickleba
88.	Among higher forms of life parental care and love are normal and essential.	88.0 Have stude affection 88.1 Propose to (which nor mating sch For exampl eggs are l the proble

ERSTANDINGS	ACTIVITIES
nternal anatomy of location and spatial the organs necessary	86.0 Have students do a frog dissection. Distinguish between food tube and oviduct in female. Observe eggs, if present. Point out ovary or testes. Have students discuss the general anatomical relationship observed. 86.1 Have students look for and bring in frog eggs. Try to get them to develop. Note: Take care to simulate natural conditions as much as possible.
s courtship activities rtners previous to ivities tend to be for the species. tion)	87.0 Use pictures and films to illustrate courtship among various animals, e.g., peacock, grunion, elephant seal, gypsy moth, sunfish, salmon, apes, mountain sheep, grouse, stickleback, etc.
ms of life parental care mal and essential.	88.0 Have students discuss parental care and affection in animals familiar to them. 88.1 Propose to the students that a pair of robins (which normally have a rigid courtship and mating schedule) has an improper schedule. For example, they mate in October, and the eggs are laid before nest building. Discuss the problems due to this improper schedule.

UNDERSTANDINGS	ACTIVITIES
89. An internal hormonal coordinating system controls higher organisms in the production of egg and sperm at proper intervals. Fertilization and development usually follow only under conditions which promote survival of the offspring.	89.0 Discuss the mate select familiar animals, e.g.,
90. Humans possess structures specialized for reproduction.	
91. The human male has testes suspended in an external sac, keeping them slightly below normal body temperature. The testes produce sperm cells, and also the hormones needed to promote secondary sexual characteristics.	91.0 Have students discuss s characteristics in male with these characterist 91.1 Point out secondary sex in other species such a rams, guppies, swordtai
92. During sexual intercourse the penis becomes specialized for the transport of swimming sperm into the female's body.	
93. The human female has a pair of ovaries located in the lower abdominal area, which produce eggs, and sex hormones.	93.0 Discuss secondary sexua in human females. Disc characteristics of othe lionesses, spiders, fis

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in the produc-
roper intervals.
ent usually follow
h promote survival

specialized

suspended in an
slightly below
The testes
lso the hormones
y sexual charac-

the penis be-
transport of
male's body.

r of ovaries
minal area,
x hormones.

	ACTIVITIES
89.0	Discuss the mate selection behavior of familiar animals, e.g., dogs, cats, fish.
91.0	Have students discuss secondary sexual characteristics in males. Are males born with these characteristics?
91.1	Point out secondary sexual characteristics in other species such as roosters, lions, rams, guppies, swordtails, salmon.
93.0	Discuss secondary sexual characteristics in human females. Discuss the secondary sex characteristics of other species such as hens, lionesses, spiders, fishes, bears.

UNDERSTANDINGS

94. In both the male and the female the pituitary gland (located at the base of the brain) is necessary for reproductive control. Since females provide the environment for the internal development of offspring, the pituitary gland regulates the female reproductive cycles.

94.0 See appendi hormonal co

95. The ovaries release eggs under pituitary influence. During egg development the ovaries produce hormones that prepare the uterine wall for the development of the embryo.

96. Following ovulation (when the egg breaks out of the ovary) the egg is moved through the oviduct, into the uterus.

97. During menstruation the uterine wall breaks down and is expelled from the body, along with the unfertilized egg.

98. Conception, or fertilization, usually occurs in the oviduct. The developing embryo later will embed itself in the uterine wall.

98.0 Discuss the negative fe trasted to the pituita eggs at onc

UNDERSTANDINGS	ACTIVITIES
nale and the female the nd (located at the base is necessary for repro- rol. Since females provide ent for the internal of offspring, the pituitary tes the female reproductive	94.0 See appendix for activities dealing with hormonal control of female cycles.
release eggs under pituitary During egg development produce hormones that prepare wall for the development of	
ulation (when the egg breaks vary) the egg is moved through into the uterus.	
ruation the uterine wall nd is expelled from the with the unfertilized egg.	
or fertilization, usually e oviduct. The develop- ater will embed itself in wall.	98.0 Discuss the birth control pill as a form of negative feedback to the pituitary as contrasted to the fertility drugs which stimulate the pituitary to induce development of many eggs at once.

UNDERSTANDINGS	ACTIVI
99. While the embryo is developing, menstruation stops.	
100. If the ovaries produce two eggs and both are fertilized and develop, fraternal twins result. However, if a single fertilized egg splits into two separate cells at the beginning of embryological growth, identical twins result.	100.0 Discuss all forms o Siamese twins.
101. The developing fetus is connected to the mother by the umbilical cord and placenta (an organ which provides food and oxygen by diffusion from the mother's blood and disposes of wastes by diffusion into the mother's blood).	101.0 Use models and char Have students diagr fetus with colored 101.1 Discuss foreign mat across the placenta rubella virus, thal
102. Surrounding the fetus is a protective amnionic sac containing a watery fluid.	102.0 Discuss the protect sac, its variation to the sac prior to
103. The period of embryonic development (gestation) varies in mammals. In man it is approximately 9 months - 270 days.	103.0 Discuss the gestati organisms, e.g., do

	ACTIVITIES	
ng,		
eggs and lop, fraternal single wo separate bryological lt.	100.0	Discuss all forms of twinning, including Siamese twins.
ected to the and placenta d and oxygen 's blood and ion into the	101.0	Use models and charts of fetal development. Have students diagram the developing human fetus with colored pencils.
	101.1	Discuss foreign materials which may diffuse across the placenta, e.g., heroin, alcohol, rubella virus, thalidomide.
rotective tery fluid.	102.0	Discuss the protective value of the amnionic sac, its variation in size, and what happens to the sac prior to birth.
lopment s. In man - 270 days.	103.0	Discuss the gestation period of other organisms, e.g., dogs and cats.

UNDERSTANDINGS	ACTIV
104. At the beginning of the birth process, pituitary hormones induce the walls of the uterus to contract expelling the baby from the mother's body. A short time later the placenta is expelled.	104.0 Discuss how the b used to identify 104.1 Discuss a mother' after she gives b 104.2 Discuss why germi baby's eyes after 104.3 Discuss the labor ketonuria. (PKU)
105. After birth, pituitary hormones initiate the production of milk from the mother's mammary glands. (3 to 7 days after birth)	
106. Although many of the fatal or degenerative diseases that have afflicted man in the past have been brought under control by environmental controls (sanitation) or by the immunization of large population groups, venereal disease has been increasing rapidly in recent years, e.g., gonorrhea, syphilis. Penicillin is not as effective in the treatment of gonorrhea as it once was.	

DERSTANDINGS

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ones induce the walls of
contract expelling the
mother's body. A short
placenta is expelled.

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of milk from the mother's
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brought under control by
controls (sanitation) or
ation of large population
eal disease has been in-
ly in recent years, e.g.,
hilis. Penicillin is not
n the treatment of
t once was.

ACTIVITIES

104.0 Discuss how the blood group of a baby can be used to identify the child's parents.

104.1 Discuss a mother's vulnerability to disease after she gives birth.

104.2 Discuss why germicidal drops are placed in a baby's eyes after birth.

104.3 Discuss the laboratory test for Phenyl-ketonuria. (PKU)

UNDERSTANDINGS

107.	Both males and females may transmit these diseases, however, the female is more apt to be a carrier because her symptoms are not as obvious.	107.0 Explai of syp
108.	If left untreated,venereal diseases can cause serious internal damage, sterility, and even death. Early treatment usually leads to recovery.	108.0 Use av discus its ca
109.	Venereal disease should be treated by a competent physician, because self-treatment and patent medicines are useless.	

DERSTANDINGS	ACTIVITIES	
females may transmit these er, the female is more apt because her symptoms are	107.0	Explain the difference in cause and symptoms of syphilis and gonorrhea.
ed,venereal diseases can nternal damage, sterility, Early treatment o recovery.	108.0	Use available literature and permit adequate discussion. Discuss sterility and some of its causes.
e should be treated by a cian, because self-treatment cines are useless.		

GENERAL BIOLOGY EVALUATION SHEET

Teacher's Name_____ School_____

School Address_____

Evaluation for Unit 3

Which activities did the students find most valuable? Which were least valuable?

Which understandings did you find interesting to teach? Which understandings did you consider the least significant?

Comments: [You may continue on the reverse side.]

- - - - - - - - -
Number of stud
General Biol
_____
Years of teach
Biology ____
General Scie
_____
General Biol
Other [ident
- - - - - - - - -

47/48

GENERAL BIOLOGY EVALUATION SHEET

_____ School _____ Date _____

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_____

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aluable?

find interesting to
did you consider

on the reverse side.]

Number of students in each class of

General Biology _____ _____

_____ _____ _____

Years of teaching experience:

Biology _____

General Science 7, 8, or 9 [check]

_____

General Biology _____

Other [identify] _____

RETURN TO:

Mr. William Calhoun
Science Education Office
State Education Department
Albany, N.Y. 12224

47/48

UNIT 4

THE GREEN PLANTS

UNDERSTANDINGS	
110. Since green plants cannot move from place to place, they are particularly dependent upon their environment. In New York State springtime provides the proper conditions of warmth, sunshine, and moisture essential to optimum plant growth.	110.0 Have stu environ time. Note: A w n
	110.1 Each stu sponsib beans o veloped flat pre
	110.2 Ask stu for pla carton
	110.3 Have ea from th into hi the nec the pro after t

ERSTANDINGS	ACTIVITIES
s cannot move from place e particularly dependent nment. In New York State les the proper conditions e, and moisture essential growth.	110.0 Have students describe the changes in the environment which occur during the springtime. Note: A list of research questions dealing with plants and their environment might be appropriate at this time. 110.1 Each student or lab partner should be responsible for the care of a seedling, e.g., beans or tomatoes. The seedlings with developed leaves should be grown in a nursery flat previous to this activity. 110.2 Ask students to bring in a suitable container for planting, e.g., the bottom half of a milk carton filled with soil. 110.3 Have each student remove his own seedling from the nursery flats and transplant it into his individual container. (Point out the necessity for planting seedlings at the proper depth, and watering immediately after transplanting.)

UNDERSTANDINGS

	110.4 Ask studen ments and importance as compare
111. The root functions as an organ of support and as an absorber of water solutions.	111.0 Show photo speculate have to be
	111.1 Use house Have stude water loss
112. All roots have living, growing parts which require a supply of oxygen for cell respiration.	112.0 Use micros of root ti
	112.1 Have stude flooding h do the roo absorption
	112.2 Have stude holes in t

DERSTANDINGS	ACTIVITIES
	110.4 Ask students to recommend possible experiments and experimental controls to show the importance of proper transplanting and care, as compared to improper techniques.
ions as an organ of support rber of water solutions.	111.0 Show photos of tall trees. Ask students to speculate on how large the root system would have to be.
	111.1 Use house plants to demonstrate wilting. Have students explain how wilting slows water loss.
living, growing parts which ly of oxygen for cell	112.0 Use microscopes to observe prepared slides of root tips.
	112.1 Have students discuss local areas where flooding has killed trees. What adaptations do the roots of swamp plants have for the absorption of oxygen from the atmosphere?
	112.2 Have students explain why flower pots have holes in their bottoms.

UNDERSTANDINGS

113. Roots absorb water and dissolved minerals from the soil through specialized structures called root hairs, which increase the surface area for absorption.	113.0 Root hair seedlings (approx. 113.1 Place a s other whi coloring. absorptio 113.2 Demonstra moss to s 113.3 Have stud needed by (Reintrod
114. Only a limited part of a green plant trunk or stem is alive and growing, this is called the cambium layer.	114.0 Bring in living br living ce 114.1 Discuss e other tre a vector 114.2 Discuss w by wrappi

UNDERSTANDINGS		ACTIVITIES
sorb water and dissolved minerals soil through specialized struc- led root hairs, which increase ce area for absorption.	113.0	Root hairs may be demonstrated with radish seedlings growing between glass plates. (approx. 3" x 3")
	113.1	Place a stem of Queen Anne's lace, or some other white flower, in a beaker of food coloring. After a few minutes note the absorption and transport of the color.
	113.2	Demonstrate water-holding capacity of peat moss to show water retention of rich soil.
	113.3	Have students discuss which minerals are needed by the green plant to make proteins. (Reintroduce cycling)
imited part of a green plant trunk is alive and growing, this is he cambium layer.	114.0	Bring in a section of a tree trunk, and a living branch with leaves, and discuss where living cells are found in them.
	114.1	Discuss effect of bark beetles on elms and other trees. Note that the beetles may be a vector of disease, e.g., Dutch elm disease.
	114.2	Discuss why saplings are sometimes protected by wrapping burlap around them.

UNDERSTANDINGS	ACT
115. The leaf is the primary site of photosynthesis. Most leaves are flat which provides for maximum light absorption, and leaves have openings for gas exchange.	115.0 Observe leaf cr scope. Point o stomates, and c 115.1 Have students p more efficient suggested?
116. Leaf veins provide support and conduct liquids.	116.0 Have students b Note the variat cle, and vein a cactus.)
117. Flowers are the special adaptations by which higher plants reproduce sexually. The parts of flowers are: Stamen: male portion of the flower 1. produces sex cells inside pollen grains 2. dispenses or disperses pollen grains	117.0 A wide variety flowers, i.e., etc.) should be students. 117.1 Discuss pollina e.g., bees, mot 117.2 Have students p adaptations for

DINGS	ACTIVITIES
ry site of photo- es are flat which light absorption, ngs for gas ex-	115.0 Observe leaf cross sections under the microscope. Point out parts including epidermis, stomates, and chloroplasts. 115.1 Have students propose models for an improved, more efficient leaf. What shapes are suggested?
pport and conduct	116.0 Have students bring in a variety of leaves. Note the variation in thickness, waxy cuticle, and vein arrangement. (Compare to cactus.)
al adaptations by eproduce sexually. are: on of the cells inside s disperses s	117.0 A wide variety of flowers (including tree flowers, i.e., willow, maple, apple, cherry, etc.) should be dissected and drawn by the students. 117.1 Discuss pollination by wind and insects, e.g., bees, moths, beetles. 117.2 Have students prepare reports on special adaptations for flower pollination.

UNDERSTANDINGS

	Pistil: female portion of flower	117.3 Have studen pressed flo
	1. "captures" pollen 2. stimulates pollen tube growth 3. produces the ovules which, when fertilized, form seeds 4. forms protection for the seed	117.4 Show photon up a demon Note: Have in ques
		117.5 Provide a v for compari apples, bea
		117.6 Place glass jelly on a "captured"
		117.7 Examine and fruits and cocoa, cof soybean pr
118.	Higher plant reproduction also occurs without flowers; for example, cuttings, stolons, bulbs, corms, runners.	118.0 Demonstrate leaf cuttin African vi

ANDINGS	ACTIVITIES
portion of	117.3 Have students prepare displays using dried, pressed flowers.
pollen pollen tube growth the ovules which, when d, form seeds tection for the seed	117.4 Show photomicrographs of pollen grains. Set up a demonstration using pollen available. Note: Have students present reports made in conjunction with 110.0 "research questions."
	117.5 Provide a variety of fruits and vegetables for comparison, e.g., watermelons, bananas, apples, beans, peas, peanuts, lemons, oranges.
	117.6 Place glass slides smeared with petroleum jelly on a window ledge for a day. Observe "captured" particles under a microscope.
	117.7 Examine and discuss foods which come from fruits and vegetables, e.g., peanut butter, cocoa, coffee, bread, cereals, corn syrup, soybean products, cottonseed oil.
uction also occurs with- xample, cuttings, stolons, rs.	118.0 Demonstrate root formation in cuttings, e.g., leaf cuttings of coleus, philodendron, willow, African violets.

UNDERSTANDINGS

		118.1 Suspend corms i bulb or
		118.2 Examine bulb.
119.	Since only one parent is involved in asexual reproduction the offspring are genetically identical to the parent plant.	119.0 Discuss grown f
120.	Some higher plants do not produce seeds, e.g., navel oranges, bananas, seedless grapes. The only way to reproduce seedless plants is by asexual means.	120.0 Show ex crabapp
121.	Plants and plant products provide many human essentials — rope, turpentine, fats, and oils, drugs, dyes, clothing fiber .	121.0 Have st on plan

STANDINGS	ACTIVITIES
	118.1 Suspend cuttings, bulbs (e.g., onions) or corms in water, observe change in mass of bulb or corm as roots develop.
	118.2 Examine the cross section of a large growing bulb.
ent is involved in on the offspring are cal to the parent	119.0 Discuss why roses and tulips are seldom grown from seed for commercial distribution.
do not produce seeds, s, bananas, seedless way to reproduce seed- asexual means.	120.0 Show examples of polyploid fruits. Compare crabapple with MacIntosh apple.
roducts provide many - rope, turpentine, ugs, dyes, clothing	121.0 Have students prepare reports or scrapbooks on plant products.

GENERAL BIOLOGY EVALUATION SHEET

Teacher's Name_____ School_____

School Address_____

Evaluation for Unit 4

Which activities did the students find most valuable? Which were least valuable?

Which understandings did you find interesting to teach? Which understandings did you consider the least significant?

Comments: [You may continue on the reverse side.]

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GENERAL BIOLOGY EVALUATION SHEET

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find interesting to
did you consider

on the reverse side.]

Number of students in each class of

General Biology _____ _____

_____ _____ _____

Years of teaching experience:

Biology _____

General Science 7, 8, or 9 [check]

_____

General Biology _____

Other [identify] _____

RETURN TO:

Mr. William Calhoun
Science Education Office
State Education Department
Albany, N.Y. 12224

55/56

UNIT 5

CLASSIFICATION AND EVOLUTION

UNDERSTANDINGS

122.	Evolution involves the change of living things over a long period of time.	122.0	Prepa typic nity. membe leave
123.	Evolution has resulted in a wide variety of living organisms. To understand their relationship to one another, man has developed a system of classification.		Note:
124.	Living things are classified into Kingdoms as plants, animals, or protists (organisms difficult to classify as plant or animal).	124.0	Discu proti
125.	Kingdoms are subdivided into phyla based upon specific body structures. Three such phyla are Protozoa, Arthropoda, and Chordata.	125.0	Show Chord chara in th of th for l

LUTION

RSTANDINGS

ACTIVITIES

es the change of living
ng period of time.

122.0 Prepare a series of cards with description of typical members of a stone age human community. Ask students to determine, which members of the population would most likely leave descendants. (See appendix for details.)

Note: Be certain to describe the harsh environment of this community.

sulted in a wide variety
sms. To understand their
one another, man has de-
of classification.

e classified into Kingdoms
ls, or protists (organisms
ssify as plant or animal).

124.0 Discuss euglena and slime molds to illustrate protists.

divided into phyla based
dy structures. Three such
a, Arthropoda, and

125.0 Show examples of Protozoa, Arthropoda, and Chordata. Point out basic structures and characteristics that determine classification in that particular phyla. Show how members of the same phyla have structural adaptations for living in specific environments.

UNDERSTANDINGS

126. Today we believe that organisms change over many years because of:

- MUTATIONS — Although usually harmful, they may occasionally give the offspring a better chance for survival.

- NATURAL SELECTION — Traits that promote survival are passed on to the next generation, as stated in Darwin's theory of evolution.

- NONRANDOM VS. RANDOM MATING — If, in a large group (population) one parental type is chosen for mating over another, that parental type will become more common, thus affecting the evolution of the species. This is known as nonrandom mating. In contrast, when fertilization occurs without specific choice of a mate, then random mating occurs, e.g., wildflower pollination and egg fertilization of clams and oysters.

126.0 Discuss mu
diabetes,
back to pe

126.1 Discuss ch
helped the
better eye

126.2 Discuss ho
chosen mat

126.3 Ask how yo
today, and
(Shows nor

126.4 Discuss ma
mountain s

126.5 Discuss th
color disp
rabbits, m
cling in s

NDERSTANDINGS	ACTIVITIES
eve that organisms change over cause of: NS — Although usually harmful, y occasionally give the off- n better chance for survival. SELECTION — Traits that survival are passed on to t generation, as stated in s theory of evolution. OM VS. RANDOM MATING — If, rge group (population) one l type is chosen for mating other, that parental type come more common, thus affect- evolution of the species. known as nonrandom mating. rast, when fertilization oc- thout specific choice of a hen random mating occurs, ildflower pollination and egg zation of clams and oysters.	126.0 Discuss mutations such as hemophilia, diabetes, sickle-celled-anemia. (Refer back to polyploid plants.) 126.1 Discuss changes in primitive people that helped them survive, e.g., better speech, better eyesight, good hearing. 126.2 Discuss how the caveman community may have chosen mates. Relate to activity 115.0. 126.3 Ask how your students might choose a mate today, and relate this to caveman society. (Shows nonrandom mating.) 126.4 Discuss mate selection of sea elephants, mountain sheep, moose. 126.5 Discuss the importance of scent in dogs, color display in peacocks, drumming in rabbits, mating call in frogs, and circling in sunfish.

UNDERSTANDINGS	ACT
Some types of nonrandom mating are: 1. the choice of a mate may be based upon physical dominance. 2. the choice of a mate may be based upon unique characteristics. • ISOLATION — This occurs when a small population is physically isolated (e.g., mountain ranges, oceans) and develops characteristics different from the parent population. These changes may or may not be an advantage to the survival of the species in their new environment.	126.6 Propose that a pure dark eyes from the main p How might their parent group? Have students d isolation.
127. Evidences of evolution have been found. For example: • Fossils indicate that evolution took place in the past leading to present organisms. • Vestigial organs are evidences of changing structure and function in higher organisms.	127.0 Show a variety fied wood. Hav of fossils or f 127.1 Have students d may form by mak or modeling cla 127.2 Discuss vestigi mentary tail, e

STANDINGS

of nonrandom mating are:

choice of a mate may be
upon physical domi-
.

choice of a mate may be
upon unique charac-
stics.

This occurs when a small
is physically isolated
tain ranges, oceans) and
racteristics different
rent population. These
or may not be an advan-
survival of the species
environment.

tion have been found.

icate that evolution took
past leading to present

rgans are evidences of
ructure and function in
nisms.

ACTIVITIES

126.6 Propose that a small group of people with pure dark eyes and dark brown hair migrated from the main population and were isolated. How might their descendants differ from the parent group?

Have students discuss other examples of isolation.

127.0 Show a variety of fossils in stone and petrified wood. Have students make plaster casts of fossils or footprints.

127.1 Have students demonstrate how imprint fossils may form by making a leaf imprint on plaster or modeling clay.

127.2 Discuss vestigial organs in man, e.g., rudimentary tail, ear muscles, and appendix.

UNDERSTANDINGS		AC
• The comparison of vertebrate embryos and skeletons shows relationships which indicate a common origin of vertebrate animals.	127.3	Show charts an and skeletons.
128. Certain characteristics have helped man become a dominant force on earth. Among these are upright posture, prehensile grip, and a superior brain.	128.0	Have students ment around pr development of
129. Man's control over his environment may be modifying his evolution.	129.0	Discuss how me survival and p genes, e.g., d

DINGS	ACTIVITIES	
of vertebrate embryos hows relationships a common origin of als.	127.3	Show charts and diagrams comparing embryos and skeletons.
s have helped man ce on earth. Among ture, prehensile brain.	128.0	Have students discuss how the harsh environment around primitive man influenced the development of capabilities to survive.
s environment may be on.	129.0	Discuss how medical knowledge permits the survival and procreation of possibly lethal genes, e.g., diabetes, hemophilia, PKU .

GENERAL BIOLOGY EVALUATION SHEET

Teacher's Name_____ School_____

School Address_____

Evaluation for Unit 5

Which activities did the students find most valuable? Which were least valuable?

Which understandings did you find interesting to teach? Which understandings did you consider the least significant?

Comments: [You may continue on the reverse side.]

- - - - - -
Number of s
General B
_
Years of te
Biology _
General S
_____
General B
Other [id
- - - - - -

61/62

GENERAL BIOLOGY EVALUATION SHEET

_____ School_____ Date_____

_____

d most

teresting to
consider

reverse side.]

Number of students in each class of

General Biology _____ _____

_____ _____ _____

Years of teaching experience:

Biology _____

General Science 7, 8, or 9 [check]

_____

General Biology _____

Other [identify] _____

RETURN TO:

Mr. William Calhoun
Science Education Office
State Education Department
Albany, N.Y. 12224

61/62

1.3 Microscopes should be first used with low power only.

"Hanging drop slides" are extremely useful for examining pr
fiberglass from an aquarium filter will provide organisms a
across the field.

4.0 Phototropism may be demonstrated with potted geraniums whic
source.

Plants or seedlings placed in a light-tight box with a smal
to and through the opening.

5.2 The processes of photosynthesis-aerobic respiration, and sy
more easily if approached from a molecular viewpoint. Mode
bonding and anaerobic respiration. Procedures may be adapt

- Trace the outline of a molecule model on stiff paper
Since each student will need to draw at least two suc
number of stiff paper copies will be needed.

- After two outlines have been traced in each student's
may be made by placing dots in the holes.

- The molecules can now be completed as shown in the di
by covalent bonds as shown in the diagram.

Note – The nature of covalent bonds might be explaine

- The basic photosynthetic equation may now be illustra

ould be first used with low power only.

slides" are extremely useful for examining protozoa for an extended time. Chopped
m an aquarium filter will provide organisms and a means for controlling their movement
ld.

ay be demonstrated with potted geraniums which will appear to grow toward a light

lings placed in a light-tight box with a small circular opening near the top may grow
the opening.

of photosynthesis-aerobic respiration, and synthesis-hydrolysis may be comprehended
approached from a molecular viewpoint. Models may illustrate covalent and hydrogen
aerobic respiration. Procedures may be adapted to show polypeptide formation.

e outline of a molecule model on stiff paper punching a small hole through each dot.
ch student will need to draw at least two such molecules in his notebook a considerable
f stiff paper copies will be needed.

o outlines have been traced in each student's notebook, the placement of carbon atoms
ade by placing dots in the holes.

cules can now be completed as shown in the diagram. <u>All</u> atoms should be connected
ent bonds as shown in the diagram.

he nature of covalent bonds might be explained at this point.

c photosynthetic equation may now be illustrated as shown.

5.2 (Con.)

- If each student cuts out one glucose molecule and folds at th
  may be simulated by attaching other molecules at these points

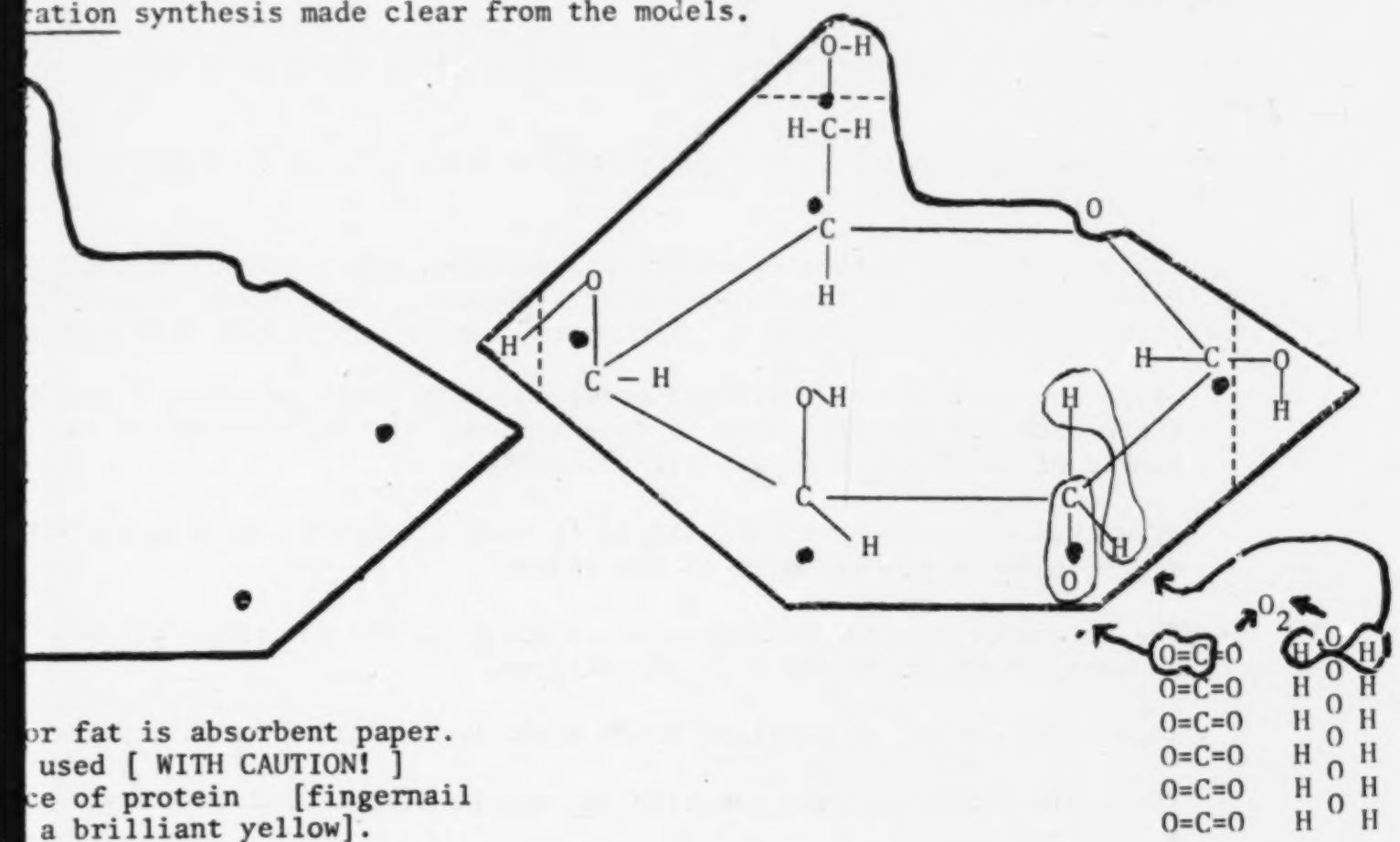
Note — Most of the molecules should be attached at the ends,
dehydration synthesis made clear from the models.

8.0 The easiest test for fat is absorbent paper.
Nitric acid may be used [WITH CAUTION!]
to show the presence of protein [fingernail
cuttings will turn a brilliant yellow].

9.0 See 5.2

ent cuts out one glucose molecule and folds at the dotted line, starch synthesis
ated by attaching other molecules at these points.

of the molecules should be attached at the ends, and the significance of
ration synthesis made clear from the models.

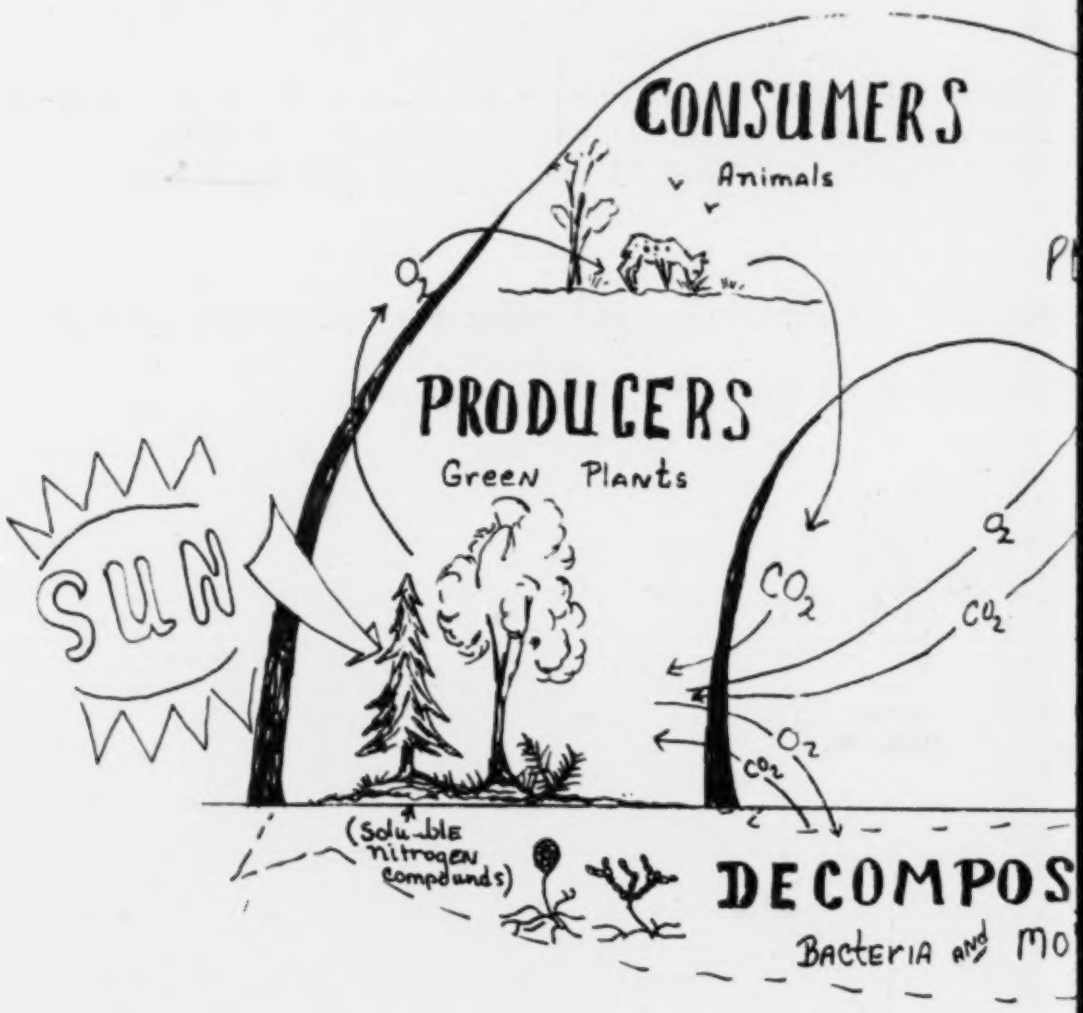


or fat is absorbent paper.
used [WITH CAUTION!]
ce of protein [fingernail
a brilliant yellow].

15.1 You might wish to discuss the relationship of insect vectors to
Rickettsiae, or bacteria to humans from other w. b. a.

15.2 A stereomagnifier may show the discrete algae and fungi that fo

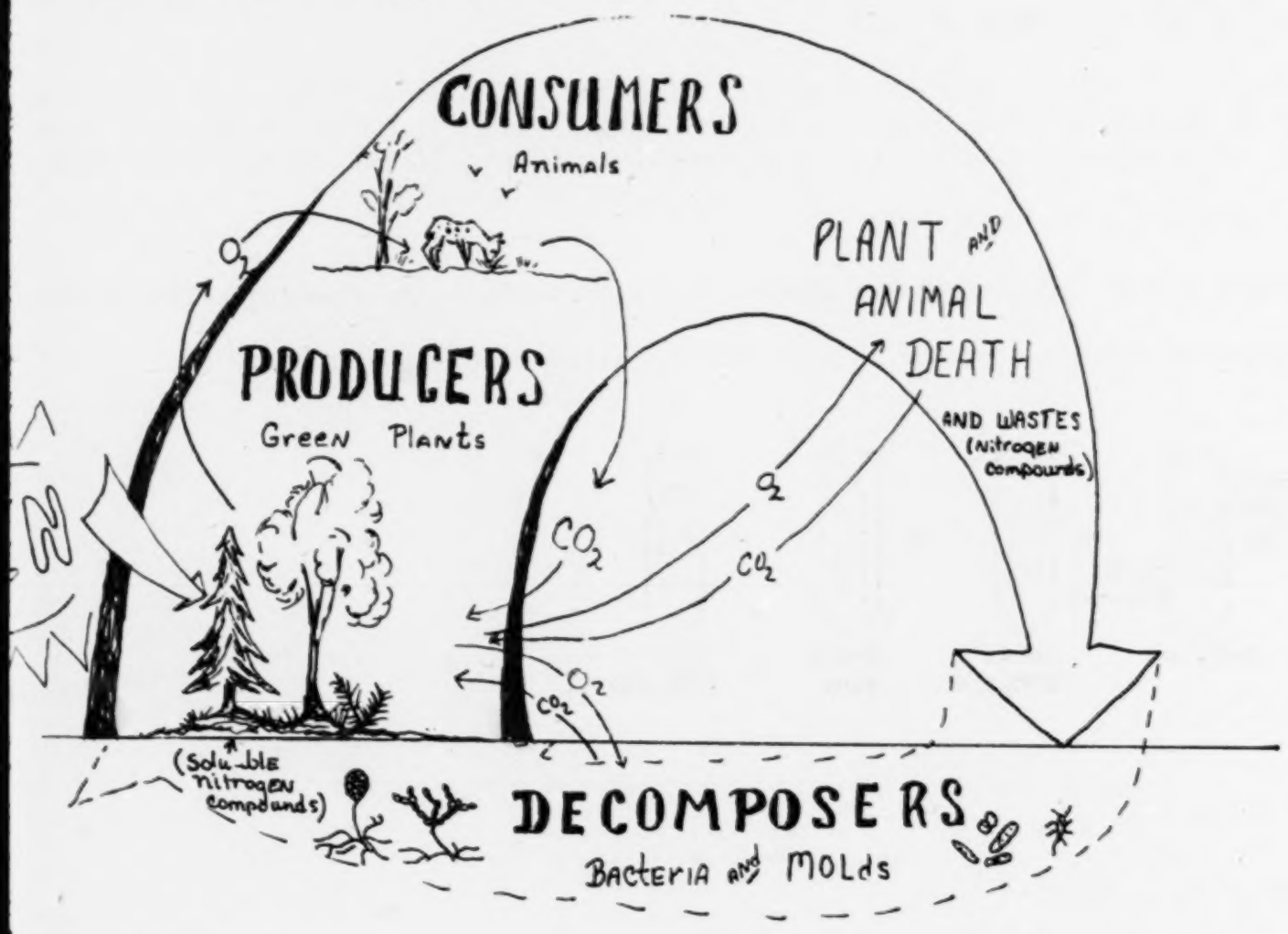
16.0 The syllabus cover also makes this representation.



to discuss the relationship of insect vectors to the transmission of protozoa, virus,
r bacteria to humans from other w. b. a.

fier may show the discrete algae and fungi that form the lichen relationship.

cover also makes this representation.



17.0 It is highly probable that the greatest biomass would be comprise

18.1 As a control, some of the hamburger could be spread thinly in a p wrap and exposed to bright sunlight for 5 minutes before it "ages

18.2 What life forms might be found in a decomposing compost pile? Wh life cycles slow down or end?

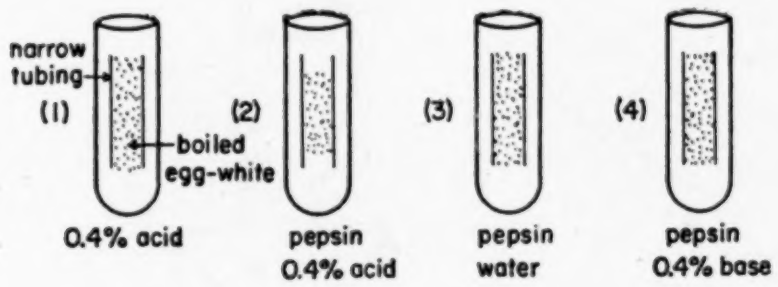
19.0 Plate counts can be made by students. Control plates should be u Plates should be autoclaved (a pressure cooker will do) before di are relatively inexpensive but will usually collapse if subjected

21.0 Is the gas really "oxygen"?

21.1 Thermal change may destroy or minimize one population and encoura

26.0 Changes in water pH can be illustrated by using color indicator d

30.



that the greatest biomass would be comprised of bacterial forms.

the hamburger could be spread thinly in a petri dish bottom covered with saran
right sunlight for 5 minutes before it "ages" for the 2 days.

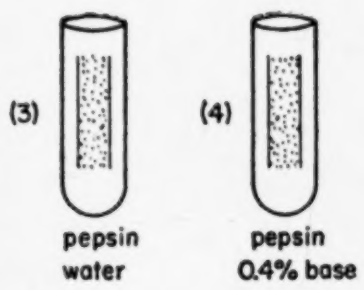
be found in a decomposing compost pile? What do they do? When would their
or end?

ade by students. Control plates should be used to show growth difference.
claved (a pressure cooker will do) before disposal. Plastic petri dishes
nsive but will usually collapse if subjected to too much heat.

ygen"?

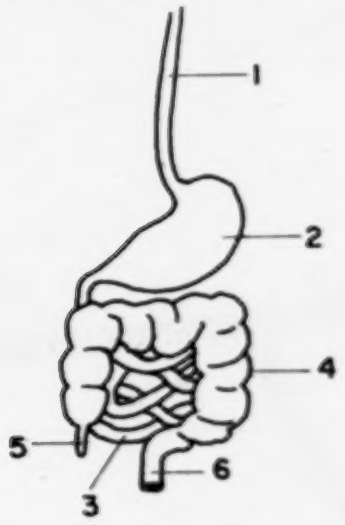
stroy or minimize one population and encourage the growth of a dissimilar one.

an be illustrated by using color indicator dyes.



id

32. **Digestive System of Man**



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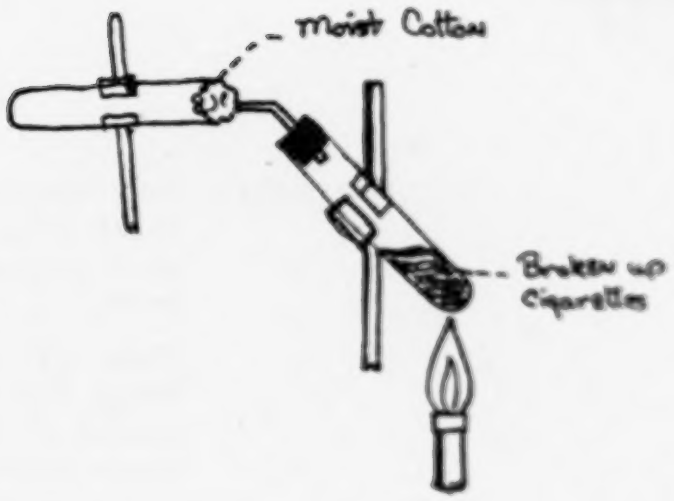
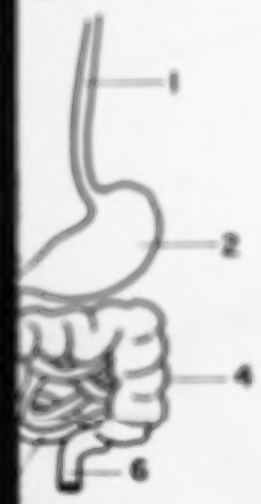


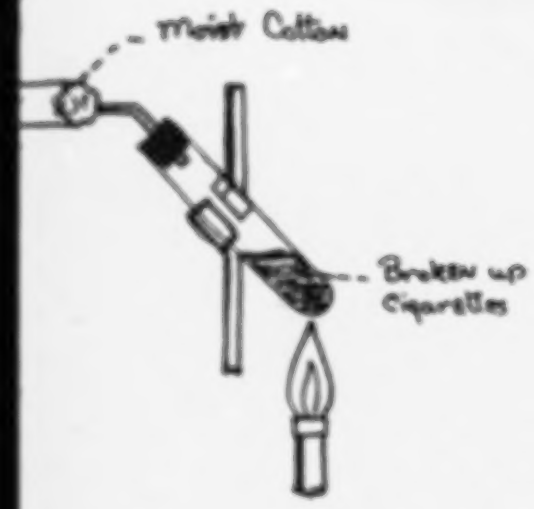
50.

Note – Point out
residue w
moist cot
walls of

67

ystem of Man





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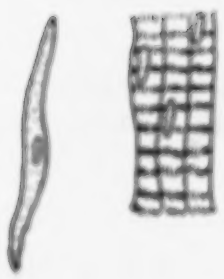
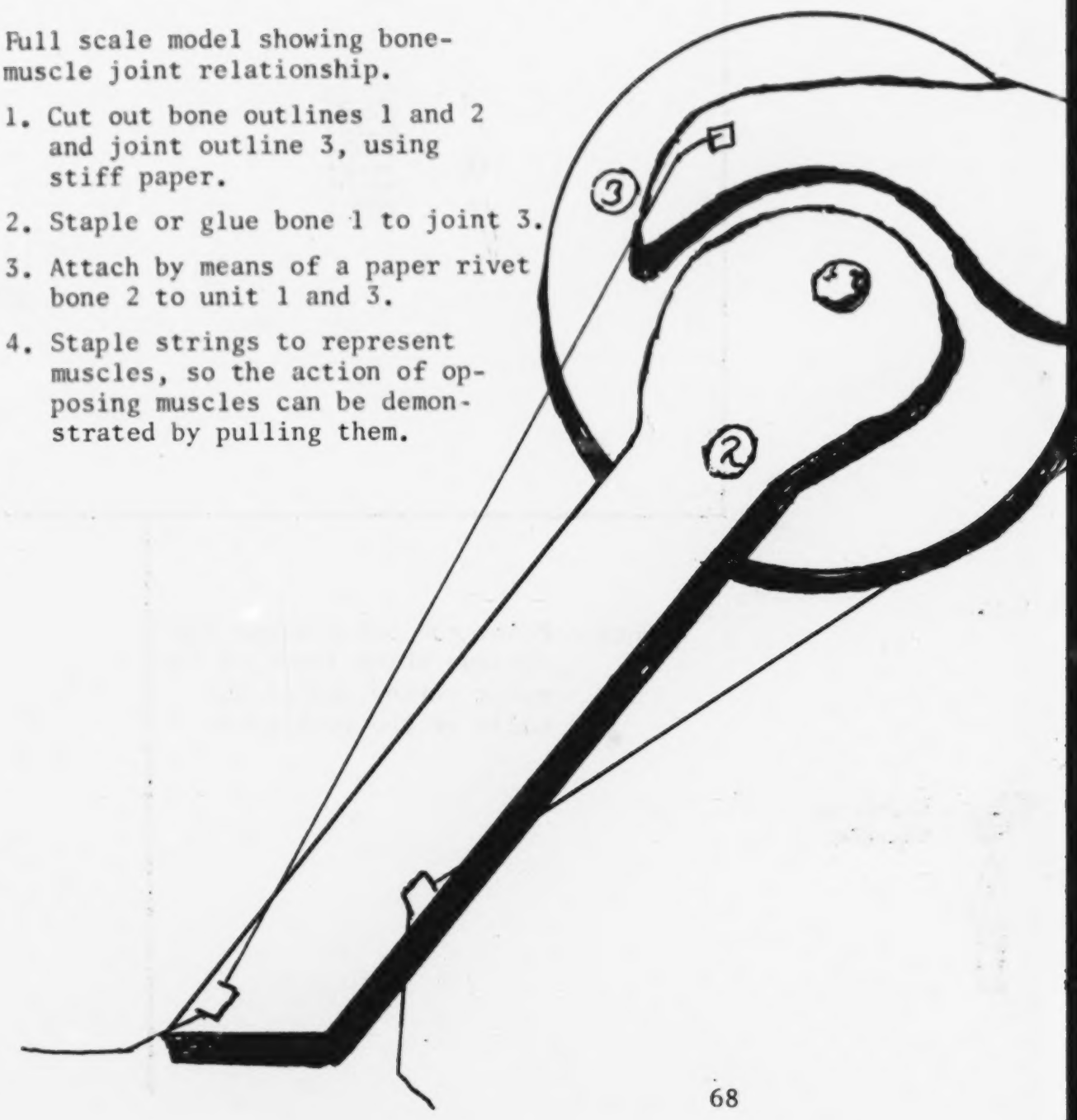


Note – Point out and discuss the residue which forms in the moist cotton and on the walls of the test tube.

52. Full scale model showing bone-muscle joint relationship.

1. Cut out bone outlines 1 and 2 and joint outline 3, using stiff paper.
2. Staple or glue bone 1 to joint 3.
3. Attach by means of a paper rivet bone 2 to unit 1 and 3.
4. Staple strings to represent muscles, so the action of opposing muscles can be demonstrated by pulling them.



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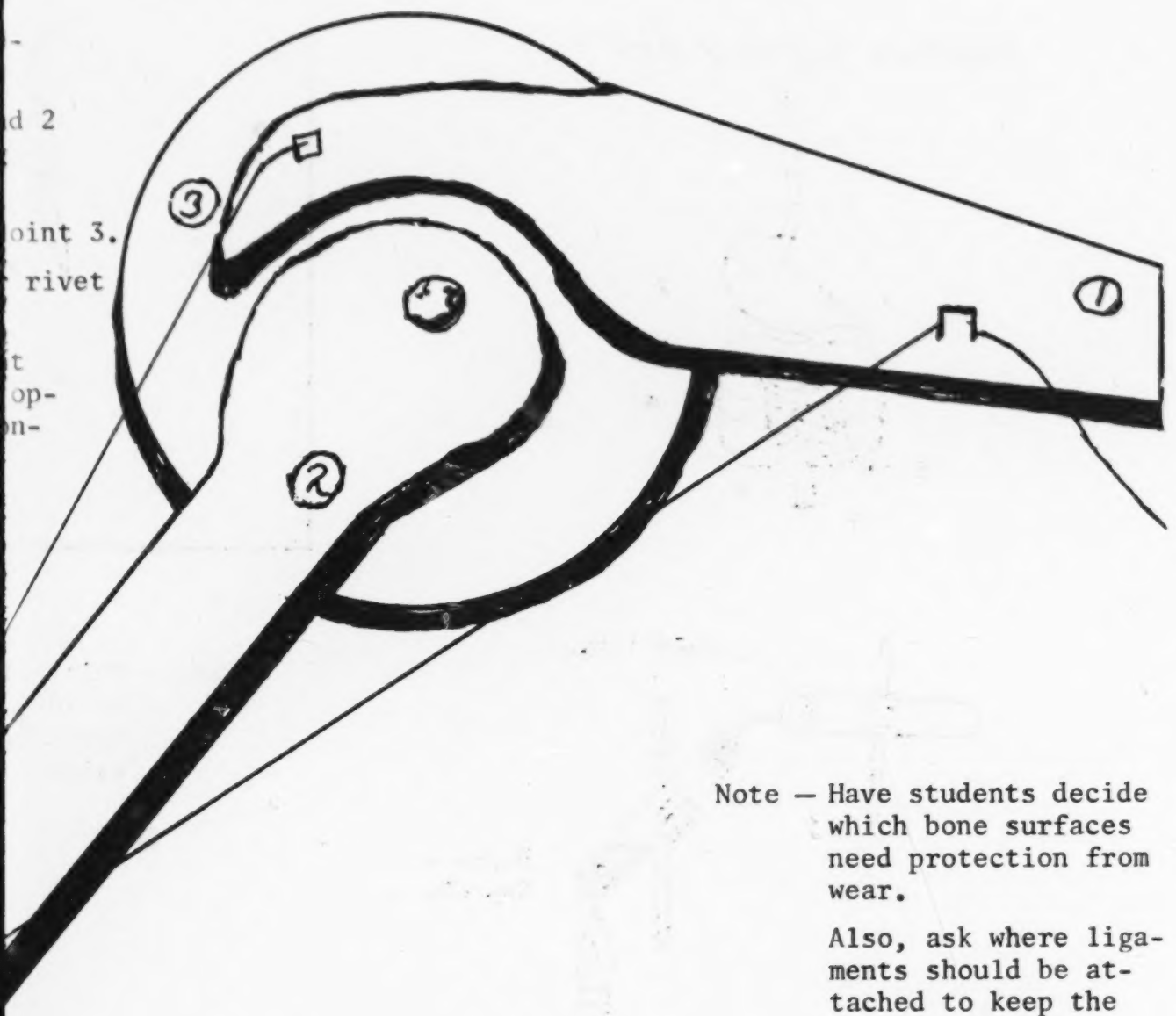


Note — Have students decide which bone surfaces need protection from wear.

Also, ask where ligaments should be attached to keep the joint attached.

53. Typical simplified pathways used in human nerve conduction

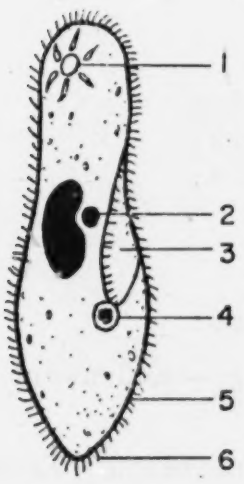
Stimulus	Sensor	Parts of the Central Nervous System	Effectors
Light	Eyes	Cerebrum	Muscles
Sound	Ears	Thinking, memory, All sensation, emotion	Muscles &
Touch	Body surface	Voluntary activity	Glands
Taste	Tongue	Cerebellum →	
Smell →	Nose →	Muscle coordination	
Muscle position	Joints	Medulla	
CO_2 in blood	Medulla	Regulation of breathing, heart beat, blood pressure, body temperature, digestion	

Suggested pathways to be explored

1. Ammonia is accidentally inhaled and student coughs.
2. Student runs a distance (note changes in breathing – and heart rate) until he is out of breath.
3. A student sights his (note the importance of the cerebrum) friend across a busy intersection and decides to run over and talk to her.

63.

64.



70

70. Mitosis: Each student should be given two sheets of colored paper
should be placed together and folded in half, so that one
four cutouts, two of each color.

Three chromosomes of distinctly different shape should be
student. They can illustrate:

1. Mitosis: Let two blank notebook pages represent t
Students may then use the cutout chromos
mitotic division, resulting in two pairs
type.

2. Meiosis: Synapsis might be indicated by the fusio
somes and the subsequent separation of h
ration of replicated chromosomes ends wi
gametes.

Note — Have students note various chromo

77. Four o'clocks are flowers that show incomplete dominance. A cross between a red (RR) four o'clock flower and a white (WW) flower produce all RW seeds. The diagram below shows a cross between two plants grown from these seeds.

Parents →	*R*	*W*
↓ *R*	1____	2____
W	3____	4____

nt should be given two sheets of colored paper of contrasting color. These placed together and folded in half, so that one chromosome outline produces ts, two of each color.

mosomes of distinctly different shape should be traced and cut out by each They can illustrate:

osis: Let two blank notebook pages represent two dividing cells. Students may then use the cutout chromosomes to show normal mitotic division, resulting in two pairs of each chromosome type.

osis: Synapsis might be indicated by the fusion of homologous chromosomes and the subsequent separation of homologous pairs. Separation of replicated chromosomes ends with the formation of gametes.

Note – Have students note various chromosome types in gametes.

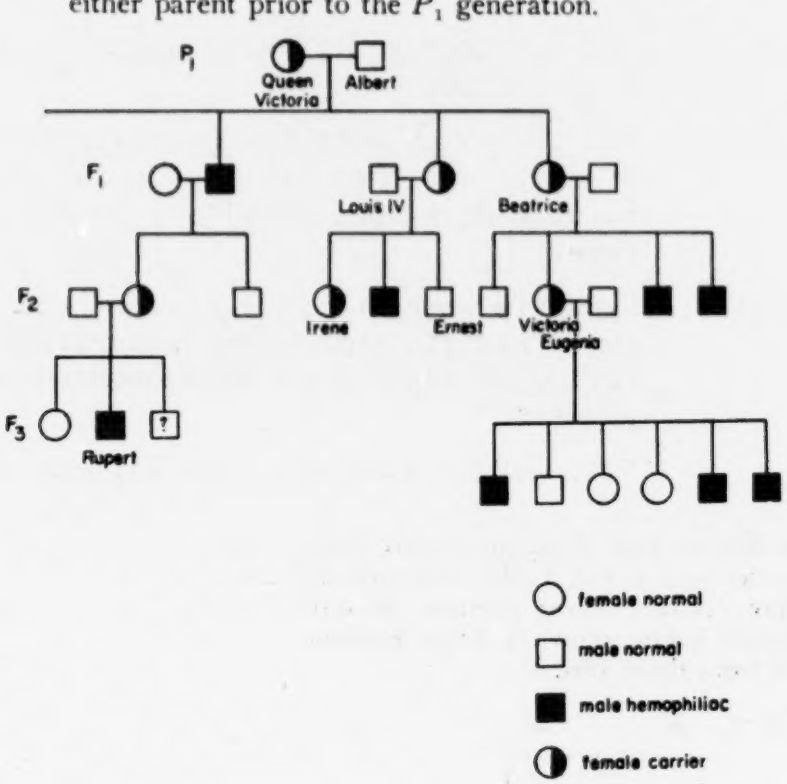
flowers that show incomplete dom- between a red (*RR*) four o'clock te (*WW*) flower produce all *RW* ram below shows a cross between from these seeds.

→ *R* *W*

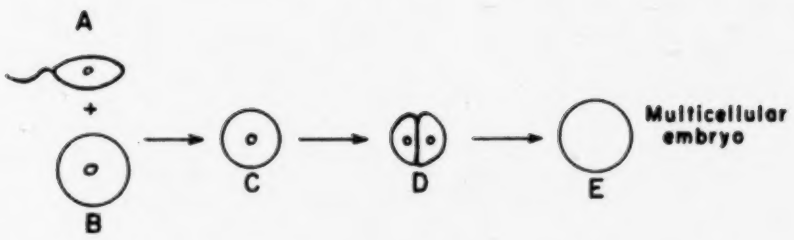
1___	2___
3___	4___

79.

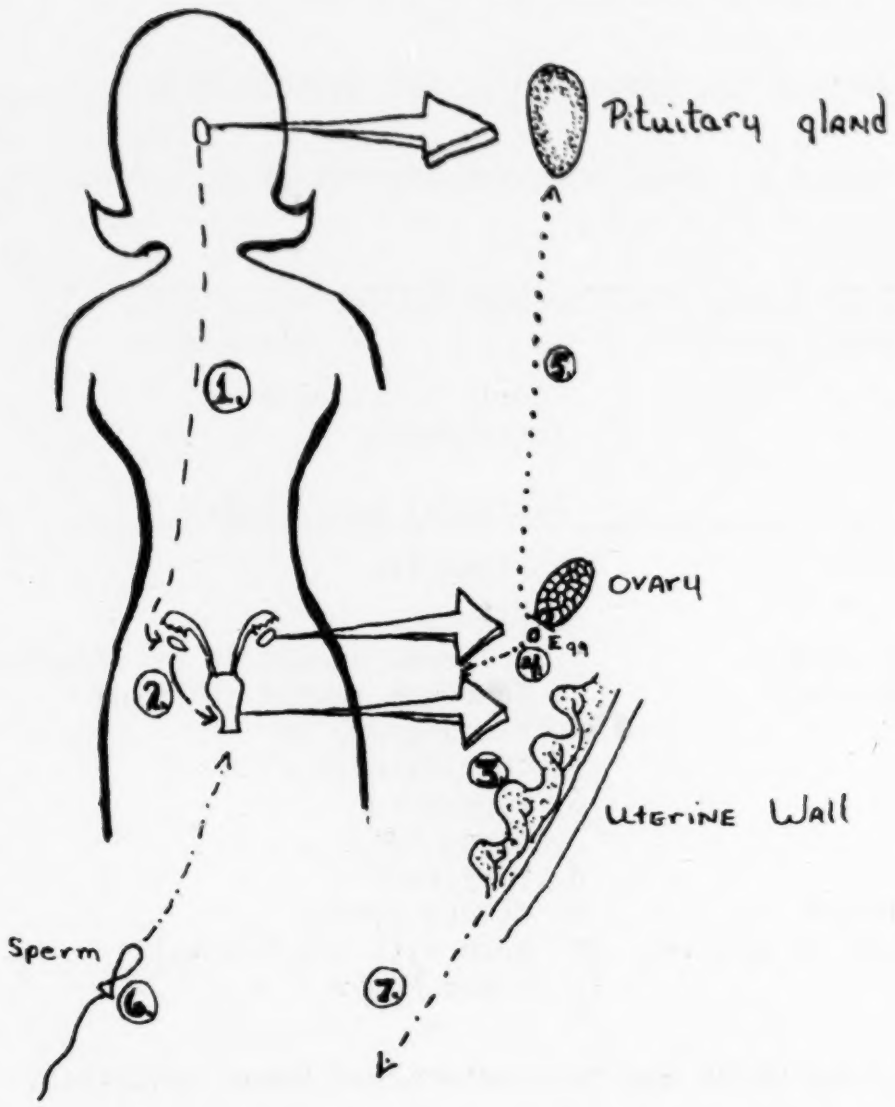
The accompanying pedigree chart shows only a part of Queen Victoria's descendants. The family tree indicates no history of hemophilia for either parent prior to the P_1 generation.



84.

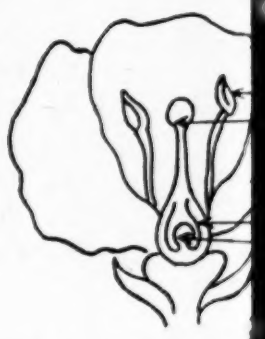


94. Female Reproductive Cycles



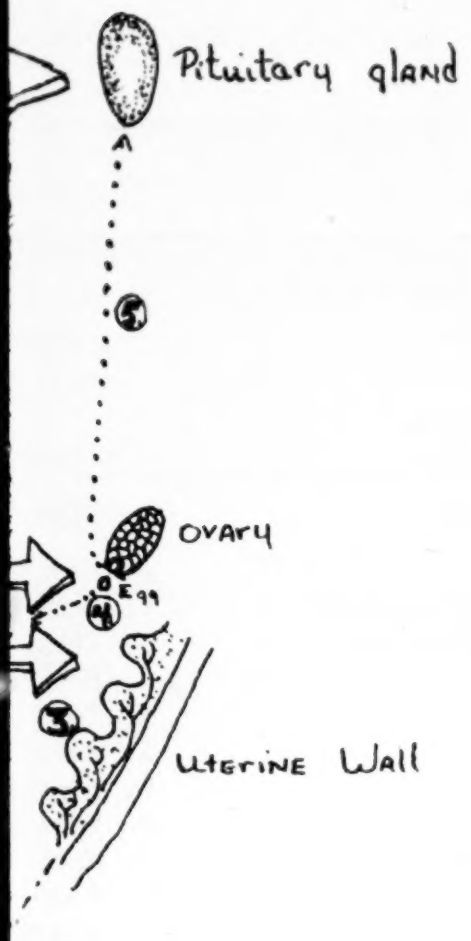
1. Hormones produced
ovary to develop a
2. The ovary produces
velopment of the u
3. The uterine wall e
vessels in respons
4. The egg matures an
(ovulation).
5. Feedback from the
to the ovary.
6. Sperm may fertiliz
the expanded uteri
struation stops du
7. If fertilization d
is expelled (menst
again.

117.



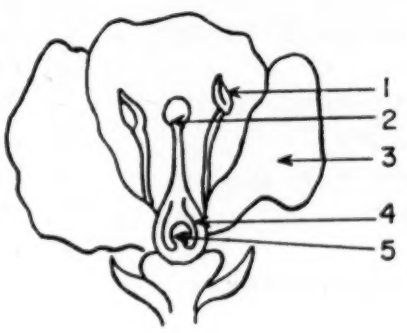
73

ductive Cycles



1. Hormones produced by the pituitary activates the ovary to develop an egg and to produce hormones.
2. The ovary produces hormones which affect the development of the uterine wall.
3. The uterine wall enlarges and develops more blood vessels in response to the ovarian hormones.
4. The egg matures and is released from the ovary (ovulation).
5. Feedback from the ovary slows pituitary secretion to the ovary.
6. Sperm may fertilize the egg in the oviduct and the expanded uterine wall will be retained. Menstruation stops during pregnancy.
7. If fertilization does not occur the uterine lining is expelled (menstruation), and the cycle begins again.

117.



122. Prepare a series of 3x5 index cards with descriptions of members of a St
After discussing the problems of living at that time, ask students to de
community described on the cards would be least apt to leave descendants
in doubt, and those most apt to leave descendants.

Three suggested cards are shown below and lists of desirable, undesirabl
follow.

Note — Hair and eye color are incidental, but are important later when t
discussed.

Male 23 yrs. brown hair brown eyes	Female 16 yrs. dark brown eyes black hair	Fema
Intelligent	Intelligent	Poor
Excellent hunter	Attractive	Inte
Blue-green color blind		
	Narrow pelvis	Extr

Desirable traits	Undesirable traits	Questi
1. Extremely intelligent	1. Hemophilia	1. Si
2. Agressive personality	2. Sickle-celled anemia	2. De
3. Physically strong	3. Poorly coordinated	3. Te
4. Capable with tools & weapons	4. Nearsighted	4. Bl
5. Enlarged larynx permitting good speech	5. Deaf	5. Te
	6. Foolhardy	6. Bl
6. Ability to withstand cold	7. Albino	7. Bl
7. Very good looking	8. Anemic	8. Ve
8. Excellent digestive system	9. Rh negative blood	9. We
9. Moderate temper	10. Weak resistance to measles	10. Bo
10. Patient	11. Poor teeth	11. Co
11. Resistant to tuberculosis		

These results may be used to discuss some of the forces which may have d

5 index cards with descriptions of members of a Stone Age human community.
roblems of living at that time, ask students to determine which members of this
the cards would be least apt to leave descendants, those which might be
t apt to leave descendants.

are shown below and lists of desirable, undesirable, and questionable traits

lor are incidental, but are important later when the effects of isolation are

n hair n eyes blind	Female 16 yrs. dark brown eyes black hair Intelligent Attractive Narrow pelvis	Female 6 yrs. brown eyes black hair Poorly coordinated Intelligent Extremely hairy body

	Undesirable traits	Questionable
gent	1. Hemophilia	1. Six-toed
lity	2. Sickle-celled anemia	2. Deformed at age 40 by accident
	3. Poorly coordinated	3. Tendency toward twinning
s & weapons	4. Nearsighted	4. Blood group AB
rmitting	5. Deaf	5. Terrified of fire
	6. Foolhardy	6. Blue-eyed
nd cold	7. Albino	7. Blond hair
	8. Anemic	8. Very tall
e system	9. Rh negative blood	9. Webbed toes
	10. Weak resistance to measles	10. Born with visible tail
	11. Poor teeth	11. Color blind

rculosis

used to discuss some of the forces which may have determined human evolution.

APPENDIX B — Bibliography

General Reference Books

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Galbraith, D. I. & Wilson, D. G. *Biological science: principles and patte* 1966.

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Schwab, J. J. *Biology teachers handbook*. New York. Wiley. 1963.

Simpson, G. G. & Beck, W. S. *Life, an introduction to biology*. Harcourt.

Weisz, P. B. *The science of biology*. McGraw-Hill. 1963.

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, W. S. *Life, an introduction to biology*. Harcourt. 1965.

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